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Established 1902

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Foundry Industry of the Irish Republic

Whilst the Ministry of Commerce and Industry of the Irish Republic records some 30 or 40 foundry concerns in the country, Colonel Hosie, the vice-chairman of the Irish Ironfounders' Association, believes that a list made up of 18 names covers all the worthwhile concerns, as the balance is made up of the one-man-and-a-boy type of shops. The industry is relatively small and employs altogether about 1,000 people. As it enjoys the benefit of a tariff on imported builders' and municipal castings, quite a high proportion of the founders include this class of goods in their production. One foundry, indeed, is mechanized for the making of rainwater goods and the like. Recently, there has been a falling off in the development of housing estates and at the moment, orders are not too plentiful.

Irish labour, intelligently and sympathetically controlled, is excellent. Wages are good and are negotiated by a board upon which the foundry industry is represented. The Irish Ironfounders' Association does not include either the regulation of wages or selling prices in its activities. One of the minor worries with labour is the non-existence of the British "pay as you earn" system and the receipt by an Irish workman of a demand for income tax is sometimes sufficient to cause his emigration to this country.

The raw materials for the industry have all to be imported. Pig-iron and coke come from England, whilst the bulk of the sand used comes from Belfast, though silica sand is available in the country as wind-blown dune-sand. Foundry machinery is supplied mainly from this country, but during the war when supplies were seriously interrupted, quite serviceable grinders and shotblast plant were "home made." As runs are short, the demand for foundry plant is of the type supplied to jobbing foundries. Whilst, in general, the Factory Acts are pretty much the same as in this country, our special Foundry Regulations have not so far been made law, but one foundry already has a bathing and washing installation which is quite popular with the younger staff, especially on Friday. Another foundry has provided a canteen, whilst a third has plans prepared for building both. If a British concern wishes to start up in the Republic, then 51 per cent. of the capital must be of Irish origin. One great advantage possessed by the Irish industrialist is that at quite short notice he can have a personal interview with the Minister of Commerce and Industry. The representatives of a few British foundry-equipment and supply houses regularly call on the founders and their visits are welcomed. One of them has recently installed the CO_2 process at an Irish foundry with outstanding success. A final note of interest

Foundry Industry of the Irish Republic

is that a coffin maker has recently put in a shell-moulding plant to make the handles! Thus, the foundry industry of the Irish Republic, though quite small, shows distinct potentialities as a market for British supplies and small-production equipment.

Latest Foundry Statistics

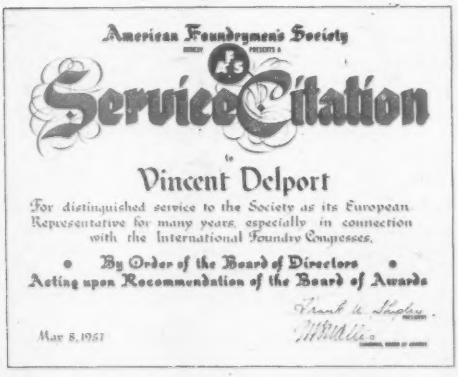
The Council of Ironfoundry Associations announces that during the week ending June 29, 1957, there were 128,307 males and 9,466 females making a total of 137,773 engaged in ironfounding. This is an increase of 748 on the total for the previous month, but 5,570 fewer than a year ago.

Monthly statistics issued by the Iron and Steel Board and the British Iron and Steel Federation for August state that employment in steel foundries on July 6 was 20,480—a reduction of 10 fewer than a month earlier, and a gain of 470 over July, 1956. The average weekly production of steel castings during July, calculated from quarterly returns, was 5,500 tons. This compares with the figures, on a similar basis, of 6,900 tons and 5,900 tons for June, 1957, and July, 1956, respectively.

Richardsons, Westgarth Orders

An order worth £700,000 for the supply of a high-pressure watertube boiler, two 12,000 kw turbo-alternator sets, and two blast-furnace turbo-blowers, has been given to Richardsons, Westgarth & Company, Limited, Wallsend-on-Tyne, by the Scunthorpe Rod Mill, Limited. The plant is for the latter company's Normanby Park Works.

Illustrated below is the American Foundrymen's Society Service Citation awarded to Mr. V. Delport (who is the Society's European representative) at the recent Stockholm International Foundry Congress. The award recognizes Mr. Delport's outstanding general service to the Society and the foundry industry. (Details of the presentation ceremony were published in the JOURNAL *of September 12, p. 311.)*


American Foundrymen's Society
Service Citation
to
Vincent Delport
For distinguished service to the Society as its European Representative for many years, especially in connection with the International Foundry Congresses.
By Order of the Board of Directors
Acting upon Recommendation of the Board of Awards
May 8, 1957

Courses in Vitreous Enamelling

This week is interviewing week at the College of Ceramics, attached to the North Staffordshire Technical College, Stoke-on-Trent, for courses in vitreous enamelling for the 1957-58 session; classes begin on Monday, September 23. Brief particulars of the arrangements are as follow.

Full-time course in vitreous enamelling leading to the manager's diploma: This is a course of three-years duration on the "sandwich" scheme, involving six months full-time study at the College and six months at a works in each year. The course includes vitreous-enamelling, metallurgy, engineering, chemistry and management subjects.

Part-time course in vitreous enamelling: This is a less-comprehensive course of three-years duration in vitreous enamelling and metallurgy, intended for those who can only be released from work on two half-days each week.

Full-time course for diploma in ceramics: This is a three-year course intended for scientific personnel. The subjects are chemistry, physics and ceramics (including vitreous enamelling).

Specialist lectures on the production of vitreous-enamelled ware: A series of twelve weekly lectures on the production of vitreous enamelling of sheet steel and castings will be given on Tuesday evenings from 5.15 to 6.30 p.m., commencing on September 30. These will be given by well-known technologists from the industry.

Further details of the courses can be obtained from the principal of the College, Dr. H. W. Webb, O.B.E., F.R.I.C., M.I.CHEM.E., F.I.CERAM.

Presentation to Frank Webster

A walnut cocktail cabinet fitted with Waterford cut glass was presented earlier this month to Mr. Frank Webster, joint managing director of August's, Limited, on his completing 40 years with the firm. He received the presentation from the chairman of the company (and his co-managing director), Mrs. F. C. France, at a staff social and dance arranged for the occasion, at the Albany Club, Halifax. Mr. Webster started work in the firm's laboratory when he left school. He was sales manager for many years before becoming a director and later joint managing director.

Mrs. France, speaking of Mr. Webster's long association with the firm, recalled some of the difficulties of the early days and the part which her late husband, Mr. G. E. France, had played in putting the company on its present basis, and paid tribute to Mr. Webster's assistance in that direction.

Mr. Webster, in thanking Mrs. France and his co-directors, said he had always been interested in sport —and sport involved team spirit. He felt that the same spirit was needed in an industrial concern; it was, in fact, present in their company.

A CONTRACT from the Central Electricity Authority for the supply of a 200,000 kw turbo-generator condensing and feed heating plant for West Thurrock (Essex) power station, has been awarded to C. A. Parsons & Company, Limited, Newcastle-upon-Tyne. A contract for switchgear for the West Thurrock and Summer Lane substations has been awarded to A. Reyrolle & Company, Limited, Hebburn-on-Tyne.

Scottish Works Visits

Scotland is noted for its hospitality and thus it comes as no surprise that for the second time* in just over three years Scottish founders have invited foundrymen from all over the United Kingdom to visit their works. The new occasion is the National Works Visits Day on October 4, organized by the Institute of British Foundrymen, when ten works, typical of the country's foundries in the Glasgow area, will be on view. The reason for this second series of visits is to enable practical foundrymen who can seldom be spared for the duration of a conference to get together just for one day to inspect the plant and processes operated by their fellows in another area, to compare notes and exchange views. In the brief accounts of the host works which appear below, the historical background is given prominence, as this is so often lost sight of when appraising the present-day status of the concerns.

In view of the outstanding success of the seven previous annual national works visits days, the Council of the Institute of British Foundrymen has decided to repeat the event this year, and has accepted the offer of the Scottish branch in making the arrangements, being greatly indebted to Mr. A. Marshall the branch secretary for undertaking this work. The arrangements made for October 4 are briefly as follow:

The host firms have been divided into groups of two (see Table I). Each group of visits will consist of a visit in the morning and a visit in the afternoon and luncheon will be provided at some suitable place about mid-day. Coaches leave from North Hanover Street (on the north side of George Square, Glasgow, for visits "A," "B," "C," "E," and "F" at 9-0 a.m. and for visit "D" at 8-45 a.m. In the evening there will a dinner and entertainment at the Grand Hotel, Glasgow.

Argus Foundry

Argus Foundry, Limited, one of the G. & J. Weir group of companies and employing some 600 personnel, is situated some five miles from Glasgow. The firm manufactures a wide range of iron and non-ferrous castings, having been established originally in 1920 in the form of a mechanized foundry for batch production. The works has continually been modernized and improved throughout the ensuing years; in 1955 a large expansion scheme was initiated and since then, a heavy iron foundry and patternshop have been added.

Mechanized Iron Foundry

The Argus mechanized iron foundry is situated in a building comprising four bays, with a total area of some 83,000 sq. ft. Metal is supplied from either a nine tons per hour; seven tons per hour, or a small two tons per hour cupola, the latter being used for special irons. The nine tons per hour unit is water-cooled and fitted with a Foxboro-Yoxall control system. This furnace is used for the main metal supply, whilst the two seven-ton units are employed as reserves. In addition to the cupolas a 50-kw. high-frequency electric furnace is employed for melting stainless steel and a 300-kw. unit, with one-ton and 5-cwt. bodies, is in process of installation. Molten iron is supplied to the mechanized section by monorail and the other bays by rail-bogie and electric-powered tractor. One of the bays of the mechanized iron

* Previous accounts of IBF works visits in Scotland appeared in the June 17, 1954, issue of this JOURNAL.

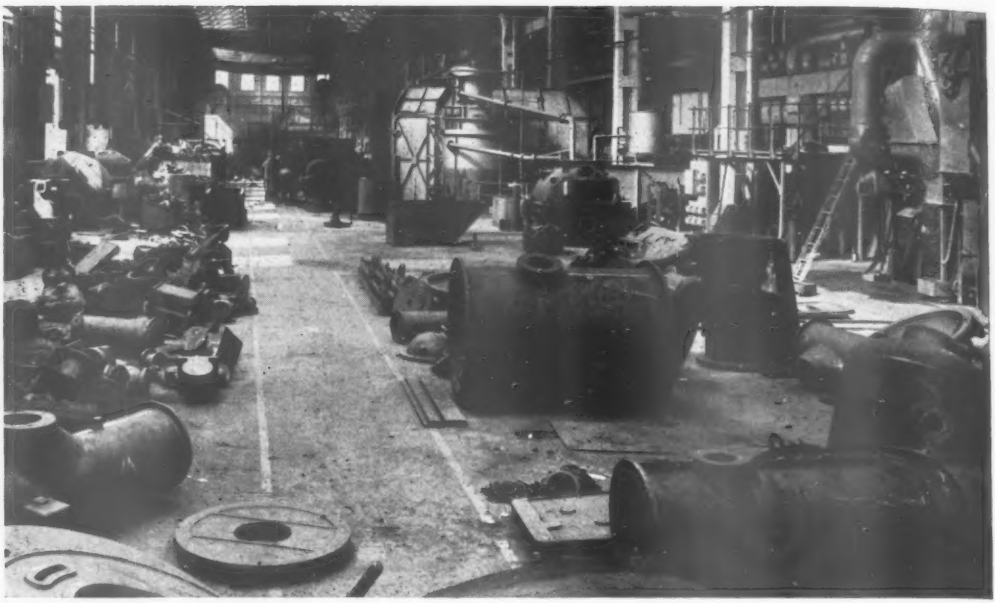


FIG. 1.—*View of one of the bays in the "heavy" section of Argus Foundry, Limited, Glasgow, showing some of the firm's products awaiting despatch.*

foundry is used for housing the cupola plant and storage bins for pig-iron, coke, sand, etc., the bins being fed from a railway spur carried into the building. Adjacent to the storage area is a gas-fired sand-drying plant with conveyor feed, supplying a coresand mixer and CO_2 sand mill.

The moulding area of the mechanized foundry is divided into three sections, heavy, medium, and light, each section being self-contained with its own sand plant and knock-out. Moulding equipment varies from a 10,000-lb. capacity roll-over machine, served by a Sandslinger (in the heavy bay) to small jolt/squeeze machines in the light casting section. Castings are produced in dry-sand, skin-dried, CO_2 sand (the gassing of which is facilitated by "piped" CO_2 supplies), and green-sand moulds, in a range, according to production section, of from two tons to five-cwt.; five to one-cwt., and below one cwt.

Heavy Iron Foundry and Dressing Shop

Production from the heavy iron foundry and dressing shop (Fig. 1) commenced some four months ago, the shop being laid out to produce a wide range of iron castings up to 15 tons individual weight. The building comprises two bays 500 ft. long and 60 and 40 ft. wide, respectively. Of the total area of 55,000 sq. ft., 40,000 is devoted to moulding, the remainder being used for dressing. Both bays are served by two 40-, five 15-ton cranes, and one of five-tons capacity, augmented by a series of small wall-jibs. Moulding is facilitated by a mobile Sandslinger, in the heavy bay, and by a static Sandslinger in the smaller bay. The mobile unit is mounted on a track extending for 200-ft. and serves three large moulding pits, together with the floor-moulding area. Sand for these two units is supplied from two 2,000-lb. capacity batch mills and auxiliary plant. Drying is carried out in a number of stoves, the largest of which is 22 by 18 by 12-ft. high (oil fired), this matching the size of the largest moulding pit.

The dressing shop contains Hydroblast (Fig. 2), Centriblast and high-pressure shotblast plants, and handles the output from all the casting shops. Also situated in the heavy shop is a mechanical shake-out unit fitted with a grid measuring 12 by 8 ft.;

TABLE I.—*Programme of Works to be Visited (by Kind Invitation of Directors and Managers of Each Company).*

Party.	Morning visit.	Luncheon.	Afternoon visit.
A	Argus Foundry Limited	Argus Foundry Limited	Alley & Maclellan (Polmadie) Limited
B	Argus Foundry Limited	To be arranged	Babcock & Wilcox Limited
C	Argus Foundry Limited	To be arranged	John Lang & Sons Limited
D	Robert Taylor & Company (Iron-founders)	Robert Taylor & Company Limited	Carron Company
E	Cameron & Roberton Limited	Cameron & Roberton Limited	Singer Manufacturing Company Limited
F	Stewarts and Lloyds Limited	Stewarts and Lloyds Limited	William Beardmore & Company Limited

the knock-out unit being totally enclosed, and the dust liberated is exhausted to an Acme Air Tumbler. Lighting of both the heavy foundry and dressing shops is by 440-v., 1,000-w. mercury-vapour discharge lamps, suspended more than 30 ft. above floor level.

Non-ferrous Foundry

Primarily, this is a jobbing foundry equipped with mechanical aids, producing, in a varied number of alloys, castings weighing from a few ounces to 2 tons. In addition to hand-moulding sections, a number of moulding machines are employed, ranging in capacity downwards from a 4,000-lb. jolt/roll-over machine. Centrally situated in the bay is a composite sand-plant incorporating two 6-cwt. batch mills each with its own knock-out and conveyor feed. The bay is served by three overhead cranes of 30-, 15-, and 5-tons capacity and a number of wall jibs. Metal is produced in a variety of furnaces varying from a 1-ton semi-rotary reverberatory to small pit furnaces. Moulds are produced in dry-sand, CO_2 sand and green-sand and in total the foundry has been designed to provide the flexibility demanded from a jobbing unit.

Patternshop, Pattern Stores and Coreshop

The patternshop and pattern stores are contained in a single-storey building 500 by 180 ft.; of this, 24,000 sq. ft. is devoted to the patternshop of which about half is for patternmaking and the rest to reception, assembly and despatch of patterns. The remainder of the building is divided into sections, separated by fire-walls, for pattern storage. The bay occupied by the patternshop is a recent addition in modern construction of pre-cast concrete. The absence of centre columns and trusses permits unobstructed layout and working. The coreshop is divided into two sections, one utilizing roll-over machines for the larger cores and the other, hand benches for small cores. Of special interest is a pendulum-type core-conveyor with automatic loading into a large Acme gas-fired stove and the semi-automatic overhead distribution of sand by monorail and drop-bottom bucket.

FIG. 2.—*Hydroblasting being carried out on a large iron casting in the fettling bay of Argus Foundry, Limited.*

FIG. 3.—*Production of an oil-sand half core for the "half-oil, half-green" sand system of core-making used in the shops of Cameron & Roberton Limited.*

Both the canteen and washrooms are housed in a modern two-storey building, incorporating on the ground floor, a large entrance hall, kitchen, etc. The men's showers are on the first floor. On one side there is a locker room for clean clothes and on the other, similar accommodation for working clothes. Each room holds 432 lockers. The first mezzanine floor contains the women's showers, again with locker rooms for clean and working clothes.

Cameron & Roberton

Cameron & Roberton, Limited, came into being when John (I) Cameron and John Roberton entered into partnership in March, 1868, and acquired the bankrupt Star Foundry in Kirkintilloch, which had formerly been built by Alexander Smith, of the same family who ran the Sun Foundry in Coatbridge. The partners manufactured rainwater pipes, gutters, heating appliances and associated fittings; in later years, water-main pipes, drain pipes and general engineering castings were added, whilst the production of heating appliances gradually

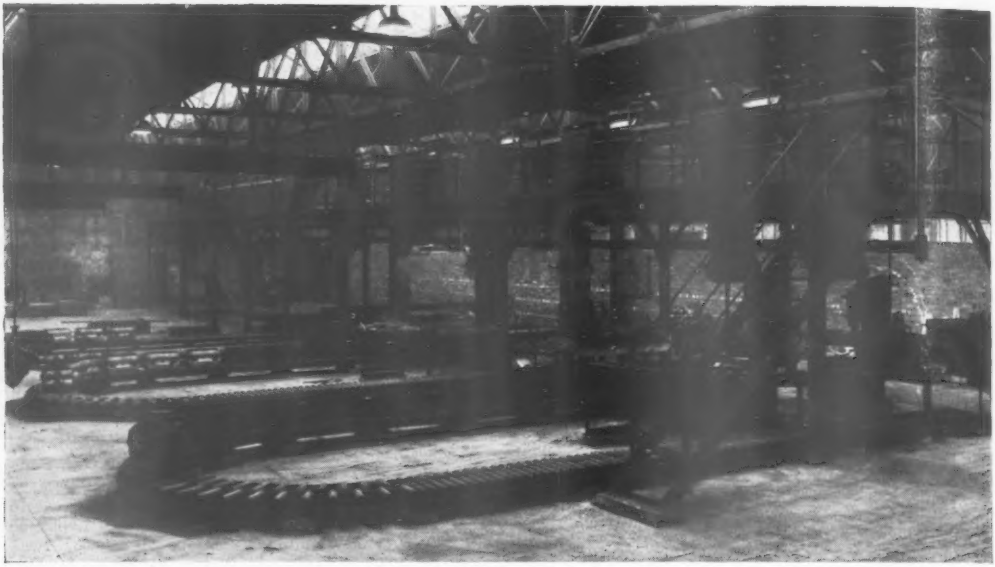


FIG. 4.—*General view of the mechanized plant for producing pipe fittings, at the iron foundry of Cameron & Roberton, Limited. The plant consists of three independent units with provision for expansion of production by the addition of a further two sections.*

declined and was dispensed with by 1925. John Roberton retired in 1890 and John (I) Cameron died in 1899) very shortly after the business had been converted to a private limited company), and was succeeded by his sons, John (II) Cameron and T. P. (I) Cameron. John (II) Cameron became well known in ironfounding circles and was president of the Institute of British Foundrymen in 1925. He looked after the rainwater-, soil- and drain-pipe side of the business, while T. P. Cameron concerned himself with the water-main, hotwater and engineering side, but it was John who initiated the production of "semi-steel" by the McLain system in 1917 and from this developed the production of bombs during the latter part of the 1914/18 war. At the peak period in 1918 more than three quarters of the output of the foundry consisted of these bombs.

Between 1900 and 1910 the moulding shops were more than doubled in area and the next major change came in 1927, when fire destroyed a considerable part of the old foundry, especially pattern-stores and dressing shop. The area effected was completely redesigned and what was pattern store was converted to the present engineering-castings' and export warehouse. In 1931, plant was installed for generating 215 kw of direct current and this proved a boon during the 1939/45 war and the subsequent years of load shedding. As public supply in the area is now adequate, this plant will shortly be closed down.

High-duty Iron Production

The early efforts with semi-steel were followed by the production of Emmel iron and finally, in 1933, a licence to make Meehanite was taken out. The production of high-class engineering castings has expanded steadily since then and was materially assisted by the third major building scheme which started in 1934. This scheme involved a new garage, gatehouse, and patternshop, a three-storied pattern-store, an additional 9,000 sq. ft. moulding area, and the complete rebuilding of part of the old moulding shops which had survived the 1927 fire. This latter building now houses the mechanized plant.

In 1935, Cameron & Roberton joined the merger which resulted in the establishment of the Federated Foundries group of companies. Production continued on traditional lines up to 1939, but the war brought major changes. Light castings production such as rainwater and soil pipes virtually disappeared, the company being in an excellent position to switch to other castings required for the war effort. Amongst items made during this period were tank-steering mechanisms, almost all the castings required by the FIDO installations, and a special breakdown service for marine engines for ships operating from the Clyde. This service frequently involved the collection of the broken part, say, a diesel engine cylinder-head, the manufacture of a pattern direct from the old casting, casting and machining the part and delivering it on board before the ship had completed its turn-round.

Present-day Set-up

Post-war development of the foundries has included the installation of a fully-mechanized plant for the production of pipe-fittings, the complete

reorganization of the dressing shop, and the replacement of many of the main items of plant. The works now occupy 8¼ acres and the foundry buildings cover 191,700 sq. ft. Employees total 423, 187 of these being skilled, 26 semi-skilled, and the remainder unskilled. Soil-pipe manufacture (Fig. 3) is the only major repetition line; the rest of the production is of high-duty and engineering grades on a jobbing basis, in a weight range up to two tons, plus some aluminium-alloy castings weighing up to 40-lb. each. There is a fully-mechanized moulding section (Fig. 4), comprising three moulding units and a batch machine-moulding department equipped with ten machines. The coreshops, the pattern-shop and engineering departments, are separately housed. Amenities are well catered for; works baths were opened in May, 1955, and a high proportion of the workmen make use of them.

The company are members of the Meehanite Training and Education Group and apprentices, who start work in a small section of their own, have the opportunity of going to the Meehanite Training School to extend and develop the knowledge of their craft.

John (II) and T. P. (I) Cameron passed on the management of the company in 1950 to John Cameron (III) and T. P. Cameron (II), who, in turn, are continuing the fascinating industry of ironfounding.

The Carron Company

The Carron Company at Falkirk, one of the comparatively few still operating under Royal Charter, was established in the year 1759—George II was still on the throne! In that year when two Englishmen and a Scotsman decided to introduce iron-making into Scotland, there were already flourishing ironworks south of the border. A suitable site—an area where there were the necessary coal and ironstone and an adequate water supply—was chosen on the banks of the river Carron, and experienced ironworkers were brought from England to instruct the Scottish workmen. In these early days, the company concentrated on making domestic appliances, such as firegrates, kettles, pans, spades and boilers.

Centuries of Progress

The company prospered and, as the eighteenth century progressed, acquired a fleet of sailing ships for transporting to customers in England an ever-increasing output of iron castings. A connection was set up between Carron company and the Adam family of architects and artists, whose designs were used in the manufacture of grates and other ornamental ironwork. The works became the experimental ground for John Smeaton, the engineer of lighthouses, and for James Watt working on his steam engines. Symington also co-operated with the Carron company when constructing his famous steamship, the "Charlotte Dundas." Towards the end of the eighteenth century, cannon balls and artillery were being manufactured at Carron. In the wars against Napoleon, Lord Nelson employed "carronade"* guns, and the Duke of Wellington stipulated that "no other artillery would do." In the nineteenth century, the Carron works provided facilities for Major-General Shrapnel to make the first shrapnel shell and to carry out firing tests. Throughout that century, also, the works continued to produce cooking and heating appliances, and in 1888 made their first gas cookers. They also began to supply porcelain-enamelled baths and sinks, and make wrought-iron gates and generally widened the scope of their manufactures.

In the present century, Carron company have kept pace with advances in science and engineering. In the early 1900's a department was started for the production of commercial and domestic electric cooking and heating apparatus. During the two world wars, a great deal of the company's capacity was diverted to the production of bombs and shells and components for tanks, aircraft and warships. The present works occupy a site of over 200 acres.

* Besides the word "carronade"—a type of naval gun made at Carron—"carron oil" also had its origin in Carron works, where the mixture was originally used for the treatment of burns and scalds.

FIG. 5.—*Static Sandslinger being used to form the bottom section of a mould for a bath casting* (*Carron Company*).

FIG. 6.—*Multiple pouring of a bath casting by means of a suspended tilting-trough type of ladle, at the iron foundry of the Carron Company.*

Foundries

The Carron foundries are now divided into two sections, one for both light and heavy castings in ferrous alloys (the latter up to 30 tons in weight), and one section devoted to producing non-ferrous castings, up to five hundredweights. These sections are served by mechanized moulding plants, Sandslingers and other plant normal to such installations. The company employs a fair percentage of apprentices, all of whom attend training centres in addition to gaining their works experience in moulding, patternmaking and fitting. Amenities for employees include the provision of a recreation club, playing fields and canteens.

(*Other foundries to be visited will be described in next week's issue of the* JOURNAL)

Steam-treated Machine Tools

Claims have been made frequently that certain simple treatments of cutting tools can increase machining output by prolonging tool life, although more often than not while the claims have in a certain measure been substantiated in practice the methods by which the end has been achieved remained wrapped in mystery. Machine tools had to be sent away for treatment, which was inconvenient, apart from anxiety that the results might fall short of expectations. A simple process is described by F. L. Spangler and M. E. Laskey of Leeds & Northrup Company, Philadelphia, USA, in *Iron Age*, June 27. Heat-treating cycle varies slightly, depending on the type of tool and material, but generally it consists of placing the tools in a suitable furnace and treating them with steam at 700 deg. F. (approx. 370 deg. C.) for ½ hr., air being excluded by maintaining the furnace at a pressure slightly above atmospheric. The furnace is then brought up to 1,025 deg. F. (about 550 deg. C.) and held for a further 30 min., the tools removed, air cooled and dipped in oil.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

BURMA, September 24—Phosphor-bronze ingots of the following composition: 10.0 tin, 0.0 to 5.0 phosphorus, 0.5 zinc, and 0.5 per cent. impurities. Quantity required 10-tons. (ESB/21887/57.)

CHILE, October 1—Water meters for the water systems of Santiago and El Canelo. Samples are required to be submitted with the offers. (ESB/21871/57.)

SOUTH AFRICA, October 8—Pneumatic hammer for the Council of the City of Johannesburg. (ESB/21844/57.)

NEW ZEALAND, October 11—Portable, platform-type scales of 5-cwt. capacity, for the Post and Telegraph Department. (ESB/21778/57.)

BURMA, September 23—Two electrically-powered (400 to 440 v.; three phase) compressors for the Union Purchase Board. (ESB/21892/57.)

SOUTH AFRICA, October 17—Grinding, drilling, planing, spindle-moulding and jig-saw machines and lathe for the Union Tender and Supplies Board. (ESB/21755/57.)

BURMA, September 23—Electric hand-drills and vertically-mounted drill press for the Union Purchase Board. (ESB/21893/57.)

PAKISTAN, October 15—Foundry plumbago for the Department of Supply and Development at Chittagong. 690 cwts. of "Blueskyn" or equivalent with 90 carbon (fixed); 2½ humidity (max.), and 2 per cent. volatiles (max.), to be supplied in flake form to pass 100 mesh. (ESB/21344/57.)

URUGUAY, October 23—Foundry stove for the Administracion General de las Usinas Electricas y los Telefonos del Estado; deposit $1,000. (ESB/21553/57.)

SOUTH AFRICA, October 2—Shake-out machine to the following specifications: Vibratory, grid-type with a grid size of six- by four-ft. suitable for moulding boxes in a large iron foundry, the machine is to be capable of handling loads up to 4½ tons. (ESB/21676/57.)

THAILAND, October 16—Diesel-engined electric generators for the Naval Quartermaster General Department, Bangkok. (ESB/21240/57.)

BELGIUM, September 27—Anti-magnetic tools for the Ministry of National Defence. (ESB/21628/57.)

PAKISTAN, September 23—Marine diesel engines for ICA procurement. (ESB/21680/57/ICA.)

INDIA, September 24—Crankshaft-grinding machine for the Director General of Supplies and Disposals. (ESB/21984/57.)

SOUTH AFRICA, October 1—One electrically-powered heavy-duty shaping machine for the Stores Department of the South African Railways. (ESB/21850/57.)

SOUTH AFRICA, October 9—One shot-blast chamber for the Stores Department of the South African Railways, together with additional shot abrasive for initial and 12 months operation and spare nozzles and adaptors (to be quoted separately). Photostat copies of the specifications are available from the Board of Trade at 11s. post free. (ESB/21847/57.)

Crossley Works Closure

Subsequent to the announcement of the decision to close the Stockport works of Crossley Motors, Limited, the Lord Mayor of Manchester has been informed by the parent company that no useful purpose would be served at present in holding a meeting to discuss the closure. The Lord Mayor, with the Mayor of Stockport, had offered to meet the directors. The managing director of ACV, Mr. W. R. Black, told the Lord Mayor that the closure was regretted but inevitable. The company would try to absorb as many workers as possible into its associated companies.

A JOINT partnership, Hochtief A.G., of Essen, Germany, and Gammon India Private, Limited, has received a contract from the Indian Government for the civil engineering work of the hot and cold rolling mills at Rourkela (the steel plant which is to be supplied by Krupp-Demag). The contract, which is worth £6,000,000, is for urgent completion within three years.

Speaking of Investments*

By H. J. Meerkamp van Embden

Speaking of investments is always a hazardous enterprise, as in this domain most casters either do not wish to, or are not allowed to change established ideas. In this Paper, however, it is intended to tackle several problems of the investing technique used to produce precision castings, basing the reasoning on simple theories, in the hope that further investigation might throw more light on the various problems.

The processes of investing wax or other dispensible patterns, can be divided into two groups: (*a*) where a ceramic shell is built on the patterns which resists the further operations of burning-out and casting; this shell may be suspended or supported temporarily by a further backing (as in the Mercast, Investment-X, and Glass-cast processes); (*b*) where models are completely surrounded by a slurry, which petrifies afterwards. A dip-coat or spray-coat may possibly help in these processes to obtain a smoother surface and/or a sharper detail from the models.

Group (*a*) processes are not applied in the Author's works so it is his intention in what follows to concentrate on group (*b*). Here, a further subdivision can be made namely, (b_1) where models are invested directly and (b_2) where the model is dipped or sprayed before applying the slurry. Group (b_1) will be treated somewhat briefly in this account and the main concentration will be on (b_2) —where a dip-coat is applied to the pattern and then a slurry backing.

Direct Investment

In group (b_1), the direct investment of the patterns requires a fine-grained mass or slurry to obtain sharp contours; a coarse-grained mass would lead eventually to metal penetration into the investment, and too-tight packing may lead to insufficient permeability. Too-high investment strength may give rise to difficulties with metal shrinkage (hot cracking), and to cracks in the investment itself during the wax elimination, drying and firing processes. The use of very-fine-grain powders may easily lead to low porosity and to shrinkage due to insufficient settling of the slurry; for this reason their use is generally restricted to small moulds and small castings. The two materials most commonly used for this process are plaster moulds and moulds of silica powder.

Plaster of Paris ($CaSO_4$ $2H_2O$), when calcined at about 200 to 300 deg. C., loses a part of its water of crystallization and forms $2CaSO_4$. H_2O, the normal calcination product. At higher temperatures, it loses the remaining combined water, and then forms $CaSO_4$. This product is not re-usable; its subsequent hydration takes a very long time and so it is called dead-burnt plaster and discarded.

The solubility of $2CaSO_4$ H_2O in water is fairly good, but $CaSO_4$ $2H_2O$ is less soluble. Thus the liquid component of the investment slurry dissolves the calcined product and becomes super-saturated to $CaSO_4$ $2H_2O$, which in the setting period crystallizes out of the liquid in the form of long needles, and precipitates as a material with about 20 per cent. water (taken on the weight of 2 $CaSO_4$ H_2O). In practice, about 50 to 60 weight per cent. of water is added to the calcined plaster. After the reaction mentioned, the $CaSO_4$ $2H_2O$ needles are

In the accompanying illustration. Mr. H. J. Meerkamp van Embden, the Author of this Paper, is shown strolling with his wife in the grounds of the Wellcombe Hotel, while attending the EICA conference at Stratford on Avon. During the conference, he was elected president of the Association in succession to Mr. W. H. Sulzer.

* Paper presented at the Stratford on Avon conference of the European Investment Casters' Association; the Author is attached to the research laboratories of the N.V. Philips Gloeilampenfabriken concern at Eindhoven, Holland.

still surrounded by water, in which they are rather loosely distributed. The more the water added, the looser the structure; this results in better porosity after drying the plaster, but it also means a poor mechanical strength of the investment. For economy reasons, fillers are often used with the plaster, mostly of silica flour. The plaster mix remains workable for about 15 min., a period which can be influenced by additives (glue is often used as a retarding agent).

Plaster moulds can only be used for casting low-melting-point metals, such as magnesium, aluminium, brasses and bronzes. Cast iron and steel melt at high temperatures, and if these metals are poured into plaster moulds, the plaster is attacked and reacts with the metals, which are thus spoiled by sulphur pick-up.

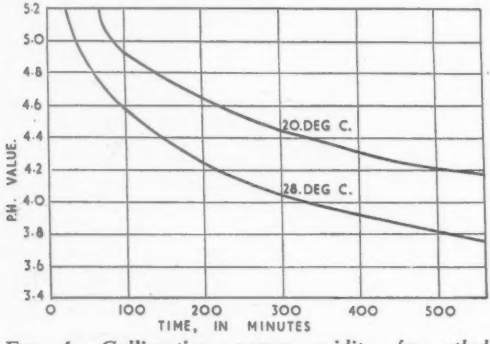


FIG. 1.—*Gelling-time* versus *acidity for ethyl silicate mixtures at two temperatures.*

Silica Refractories

A second method uses a finely-ground refractory, mostly of silica flour of below 60 microns particle size. Special precautions against silicosis are needed when employing this medium, because these fine dusts are very aggressive. Even thorough flushing of the floor with water is insufficient, for a certain amount of the powder remains and walls, machinery and products are usually forgotten as sources of contamination or toxic properties.

When such a powder is dispersed in an aqueous liquid, as in an investment slurry, there are two possible results. The first is that attraction forces exist between the particles, so that, after stirring, the parts flocculate together and form very loose structures which settle down. The second possibility is that where a repulsing force set up between the particles (built up by surface charges) is preponderant to the attraction forces. When this is the case, there is a "stabilized suspension"; *i.e.*, the particles will not flocculate and form loose structures as each repulses the other. When a suspension of this type is left to settle, dense packing is the outcome, as each particle comes down to the bottom without forming the loose flocculant structures of the first type, *i.e.*, the unstabilized suspension (Fig. 2). The same quantity of particles, when settled in stabilized suspension, takes up much less volume than when in unstabilized suspension, and when water is eliminated, the sediment of a stabilized suspension is much denser and harder and will not crack during drying and firing. Hence, a stabilized suspension must be aimed for when preparing investment slurries of this type and here, the investment problem is seen to be translated into a colloid/chemical process. There is also another snag, however, namely, that the hard stone as results from such packing may be so dense that the metal, when cast, cannot break up the mould on shrinking, resulting in hot-tears in the metal. Thus, one can be once more "between the devil and the deep-blue sea"—a position only too well-known to most foundrymen.

Duplex Treatments

Passing on to group (b_2)—dip- or spray-coating followed by slurry investment—some general remarks on the materials will first be given. The dip-coating material and the slurry are in both cases suspensions; with dip-coat, the suspension is of a fine-grained material and with the slurry it consists of a mixture of coarse- and fine-grains, in a liquid. The liquid serves two purposes; first, that the mass must be workable and the waxes can be dipped or sprayed, or the slurry cast as a liquid. After this, the slurry must settle to permit removal of part of the liquid. The next purpose is that the liquid must act as a glue between the grains to keep them together. Moreover, when the dip-coat is in contact and wetted subsequently by the slurry, the "glue" must remain intact, otherwise the dip-coat would be swilled-off from the patterns.

The most commonly-used binder is composed of silica gel, in the first place because it can be applied in the aqueous suspension and also because it remains after drying and calcination. When organic substances are used as binders, they will decompose between, say, 200 and 400 deg. C., so that a second product which "glues" at higher temperatures must be added. For this latter purpose, phosphoric acid and phosphates are among the products prescribed.

In this Paper, however, attention is concentrated on silica, and this in the form obtained by the decomposition of ethyl silicate and its homologues. The Author prefers this form to the use of sodium silicate and its derivates for various reasons: the first being that his firm is used to it and find it "easy to handle," but it does have other advantages —the decomposition of ethyl silicate gives pure SiO_2 and alcohol which volatilizes, this in contradistinction to sodium silicate where it is impossible to get rid of the sodium, which remains in the form of sodium chloride or sulphate or some other salt. The presence of these sodium salts may lower the refractoriness of the investment and cause bad surfaces or dreaded "skin"* defects on the metal surface. Furthermore, there is a danger, when firing a siliceous material which contains sodium chloride, of the following reaction taking place at

* The Author defines this skin as consisting of melted oxides mixed with penetrated metal and inclusions of refractory grains.

high temperatures: $SiO_2 + 2NaCl + H_2O \rightarrow Na_2SiO_3 + 2HCl$—just the reverse of what is obtained with the aqueous solution of the silicate. This means that, in the calcination period of the investment at high temperatures, hydrochloric acid is developed, which can corrode badly the metal flasks and furnace equipment (this was proved by the Author's tests, where the addition of sodium chloride to the normal investment slurry caused a serious corrosion of the stainless-steel flasks when firing the mould).

Alternative Silicate

Tetra-ethyl silicate is split up or "saponified" into silicon oxyhydrate (siliceous acid) and alcohol, the reaction being produced by adding water and dilute acid:—

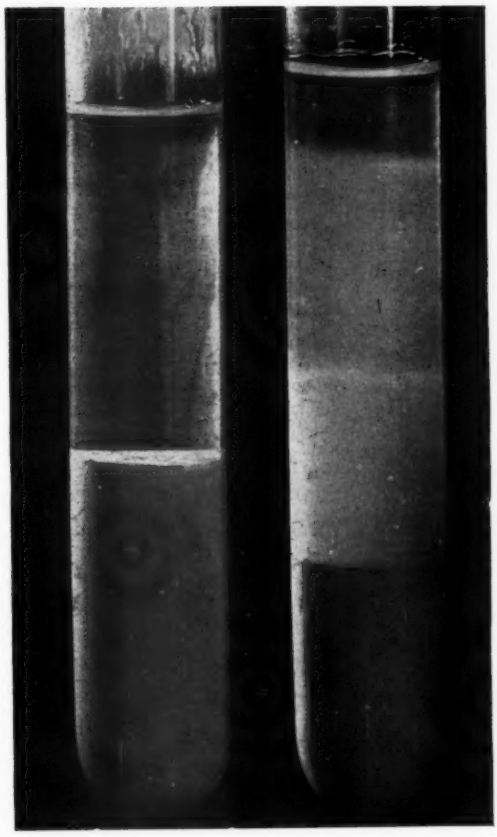
$$(C_2H_5O)_4Si + (n + 2)\,H_2O = 4C_2H_5OH + SiO_2\,nH_2O$$

Converting the siliceous acid to SiO_2, 1,000 gm. of the silicate forms 280 gm. SiO_2 and 880 gm. alcohol. There are also so-called polysilicates available which contain more SiO_2 and these, when decomposed, give per 1,000 gm.: 400 gm. of SiO_2 and 800 gm. of alcohol. In this respect, they are preferable to the tetra-ethyl silicate, as it is desired to employ only the silica, the alcohol being driven off when drying the moulds and therefore of no further use. However, this polysilicate is a rather crude product; the tetrasilicate being purified mostly by distillation which is impossible in the case of the polysilicate, since the product decomposes before distilling off. In the case of foundry investment materials, however, high purity is not necessary and the crude polysilicate can profitably be used, and is cheaper. The process of saponification is less easy when the polysilicate is used, but the problem can be solved quite readily.

The assessment of the quality of ethyl silicate for investment purposes by a distillation test is, in the Author's opinion, rather nonsense. This method may be valuable for testing the material when intended for organic synthesis, but never for investment liquids. The saponification reaction (the hydrolysis which results in the splitting-up of the silicate into alcohol and siliceous oxide with the help of water and a small amount of HCl as a catalyst) gives the siliceous oxide in a colloidal dispersed form, and this colloid or gel remains unaltered under the influence of the acid, and can be kept for several days without decomposition. When the acidity is reduced, however, the suspension becomes unstable; the siliceous particles surrounded by a quantity of water molecules flocculate and form a homogeneous gel. The more liquid enclosed betwen these SiO_2 particles, the less SiO_2 is needed to bind the whole mass into a gel, so flocculation must be obtained of the SiO_2 with only as much water as is necessary for a homogeneous gel.

Other Considerations

When adding acid to a sodium silicate solution (water glass) there is also a flocculation of siliceous oxide, but here, gelling starts before binding all the sodium; moreover, this gel binds less liquid; the refraction index is higher and the gel looks white. Further, as a result of kneading the mix, a part of the liquid can be separated and an inferior binding quality can then be expected. Ethyl silicate gives a gel of fine quality, and another advantage is that with it, the gelling time is well controllable. The liquid obtained by saponification with HCl is fairly stable, then, during reduction of the acidity, the stability diminishes more and more and gelling takes place in a period, the length of which depends on acidity, salt content of the solution, and temperature. In the graph (Fig. 1) (on page 340), gelling time is plotted against acidity; the two lines being plotted for temperatures of 20 and 28 deg. C. By fixing the acidity, the gelling time is under control and it can be fixed, for example, at four hours, which is sufficient to allow the sludge to settle before gelling. Another method is the addition of MgO to the



(*a*) (*b*)

FIG. 2.—*Test-tubes containing* (*a*) *an unstable suspension of a powder in a liquid* (*after settling*), *and* (*b*) *the same quantity of powder settled over the same period of time in a stabilized suspension.*

slurry; the MgO dissolves slowly and binds the acid, and the magnesium ions in the liquid help to reduce gelling time. It is doubtful, however, whether the decomposition of the MgO is sufficiently reproducible, as its reactivity depends on the calcination temperature used in its preparation and on its grain size.

In the dip-coat, gelling is caused by the evaporation of the water/alcohol mix of the liquid during drying. This gelling by change of concentration is irreversible, so that the subsequent filling of the moulds with slurry will not dissolve the dip-coat.

Ceramic Mass

Having dealt with the binding agent, the ceramic mass will next be considered. The refractory properties are of primary importance; the material must not become attacked or melted during the pouring of metal into it, nor must it react with the molten metal or the oxide films on it. Here, then, is a major difference from the ordinary types of moulds as used for iron or steel, where the binding agent is usually composed of clay. Clay and bentonite have a rather low melting-point, and, when fused, react easily with iron and oxides and even with the refractory itself. This reaction may produce a rough surface on the casting as a result of the mould surface being attacked and may lead to the so feared "skin" formation, mentioned earlier, which is very difficult to remove. This defect is most serious when casting steels at 1,600 deg. C.; with cast iron, the difficulties are fewer (casting temperature 1,400 deg. C.) and most bronzes, brasses and aluminium can be cast even in loam sand without trouble.

Author's Procedures

In the Author's investment, the refractory is glued together with silica, which melts at about 1,700 deg. C. A mould is obtained which reacts hardly at all with metals or oxides; thus, no skin forms and a sharp impression of the pattern is obtained.

The choice of refractory will next be referred to very briefly; one can choose from zirconium silicate and sillimanite to fireclay grog and between materials of different porosity, specific weight and softening point. Quartz and silica may cause trouble, for several allotropic forms are possible, and, when heating up, one form may change into another which may cause volume changes and cracking of the crystals and moulds. Then there is the danger of silicosis, especially with the fine powders. Calcination at more than 1,100 deg. C. changes the quartz into cristobalite which is rather more stable, so that then the sudden volumetric changes from low-temperature quartz into high-temperature quartz can be avoided. But the calcination rather increases the cost of natural sands, and the danger of silicosis is not eliminated.

It should be borne in mind that the major quantity of investment material is used for the moulds; for the dip-coat only a small fraction is necessary, so the latter may be more expensive per pound. From the dip-coat, good refractory properties are required to avoid fusion of the material when hot metal is poured into it, no allotropic phases (as with quartz) can be permitted and a very fine grain is necessary to obtain an exact replica of the wax surfaces. The porosity of such a layer is rather low but the layer is very thin, which is a compensation.

Dipping Slurries

As to the dipping slurry, special properties are required for this also. If the slurry be too thin, it will not cover the pattern surface but streams down and as a result, the layer applied is too thin. If the slurry be too thick, there is the danger of included air bubbles which give rise to metal "pearls" on the casting. A certain thixotropy is necessary; this means that the ceramic particles should show some attraction towards one another, so that on the surface a loose network is formed which prevents dripping off. This attraction, however, needs to be so small that when the mass is stirred, it behaves as a liquid. On the other hand, a non-thixotropic liquid, such as sugar syrup or tar, can be very thick when applied but remains a liquid and continues dripping off. Thixotropy is also the reason why sufficient thickness can be retained at the sharp edges of patterns; with a non-thixotropic liquid, these edges will always show through a dip-coat layer. Dipping is often followed by spraying with dry sand or refractory, which helps to thicken the liquid layer and acts as a mechanical bond to the slurry.

Next, the coating has to be dried. During this operation, the thickness of the layer diminishes, for the refractory grains pack together as the water between them disappears. For this purpose, the liquid must not be gelled, as this would impede the moving of the grains. The gelling must take place at the end of the drying period, but in the drying operation—and therein lies another snag. Drying means evaporation of water (and alcohol), and the heat abstracted during evaporation cools the wax patterns. When the evaporation speed is slow, these calories are replaced by the surrounding air and there is scarcely any drop in the temperature of the patterns, but at low humidity of the surrounding atmosphere, the temperature of the wax models may drop well below the ambient temperature and on several occasions, the Author has measured a temperature drop of about 10 deg. C. This can be disastrous, for the pattern shrinks and at the low temperature at the end of the drying period, the dip-coat sets. When, after this, the models return to ambient temperature, the wax expands but the dip coat expands less and cracks result, the more so if the bond between the dip-coat and wax is weak—especially at edges and on flat surfaces. This may give endless troubles and lead to defective castings arising for no obvious cause at irregular intervals, as it is clear that the temperature and relative humidity of the atmosphere can vary from day to day and can be very low in summer as well as in winter, when the rooms are heated. Once detected, however, the remedy for this trouble is obvious—keep the relative humidity so high that a steep drop in temperature during drying cannot

occur, the evaporation being spread out over a longer period.

Investment Slurries

Passing to the investment slurry, three properties should be looked for: castability, porosity and settling. For these three, a certain optimum grading of the refractory is necessary. When using a fine-grained mass in the liquid, the castability may be excellent but the porosity will be very poor, and settling will take place with difficulty; this results in contraction and cracking of the moulds when drying. A coarse-grained material is not castable, it separates immediately and is too porous as a mould, so that there is a danger of metal penetration. In this respect, methods of mixing concrete might be examined for parallels with investment mixtures. Here, sands and gravel in very definite quantities are mixed so that a castable mass is formed which fills cavities without any separation.

Compaction of Investing Material

After filling, the moulds are usually vibrated, resulting in a dense packing of the coarse grains which touch one another, the voids between them being filled with the finer grades. Too much coarse material results in too-rapid settling and then the material flows insufficiently. This results in a loose packing especially underneath the patterns. Here, too, much liquid gathers so that, when drying, the mass shrinks away and the dip-coat in insufficiently supported at these places and tends to break through, followed by metal penetration into the voids on casting. The remedy is to select the right composition for the mix, to arrange sufficient vibration and to avoid placing the wax patterns so as to present large horizontal planes in the mould. As regards settling, Stokes' law must also be remembered; *i.e.*, the speed at which the particles settle depends on their specific gravity, their dimensions and on the viscosity of the surrounding liquid. This last means that the suspension agent has to remain a liquid throughout the whole of the settling period, and only after settling may viscosity increase to gelling—certainly not before or while settling.

Conclusion

The Author has tried to give a " bird's-eye " view of the many problems which are of importance in investment procedures. Obviously a complete picture has not been given of this highly-complicated subject, but it is hoped that this contribution may result in a better understanding of what metallurgists are doing in this field for ceramists and colloid chemists and may lead to better investment castings and fewer rejects.

DISCUSSION

THE PRESIDENT (Mr. W. Sulzer) took the chair for the discussion on this paper which was opened by MR. I. V. DI SAMBUY, who asked what the Author meant by " stabilizing." Was it a matter of the size of the grain and/or the type of particle, did it mean a special chemical treatment or was it a question of the suspension liquid?

MR. MEERKAMP VAN EMBDEN replied that when one referred to a " stabilized " liquid, one meant that at the surfaces of the particles there are ions going into solution, so that the solution is loaded against the solid particles. For example, when a solution is negative, the particles are positively charged and, as equally charged particles reject each other, the force of rejection might be greater than the normal attracting force between them. So that at the moment of settling of a stabilized suspension, the particles being in a state of rejecting each other, one has a more or less perfect liquid. In an unstabilized suspension the particles attract each other after dispersion by stirring, and when they come together they form a loose structure and behave more or less as a solid.

The forces become less and less as the weight and settling speed of the particles increases, so that when the particles are large the forces are of minor importance. In suspensions in the colloidal state, however, the forces become very important to anyone who is studying the problem.

MR. DI SAMBUY then asked if it were the fact that if the properties were the same, the liquid was the same.

MR. MEERKAMP VAN EMBDEN replied that the liquid was not the same; it was such that it had stabilizing properties. The idea was to use a liquid which attacked slightly the solid surface to get ions formed, but prevented flocculation from other causes.

Alternative Materials and Methods

MR. H. LISTER (Fairey Aviation Company, Limited) commented that he had found the Author's remarks regarding the use of sodium silicate to be provocative, in that he had used this material as a binder in the production of thousands of castings and the results were quite as good as when ethyl silicate was used. The Author had referred to a reversible reaction; but also during burning off, sodium silicate absorbed more silica, producing a saturated glass which was more refractory.

Recalling the Author's statement that the drying of the dip-coat was important and his reference to the effect of humidity, he asked how humidity was controlled; did the Author make an addition to the dip-coat which slowed up the drying rate?

THE AUTHOR replied that there were " many ways to Rome." A number of founders preferred to use sodium silicate as a binder and they obtained very good results with it. It had its advantages, especially as to price; but, as he had said, his organization had tried it several times and the results obtained in their tests and in tests by some of their friends were less encouraging. They had not had time to begin again at the beginning and got a good start with ethyl silicate, and thus they advocated its use as one medium, although it was not the only one.

With regard to humidity control, he believed the addition of glycerine was used on a fairly large scale, but he had some objections to it. Glycerine did not evaporate, so that drying would be always more or less incomplete. It might retard the drying, but it would not stabilize, and in his opinion

Speaking of Investments

the results could be made reproducible only by controlling the humidity of the surrounding air.

MR. G. A. MITCHELL (Deloro Stellite, Limited) considered that it might be worth recording that when the process was introduced from America in 1941, the ethyl silicate which was sent over was straight tetra-ethyl silicate containing 28 per cent. of silica. This required strict chemical and physical control to prevent premature gelling. The introduction of condensed or polymerized ethyl silicate containing 40 per cent. silica provided additional silica available for binding and allowed greater latitude. This helped the process considerably. Pure tetra-ethyl silicate could be made by the reaction between silicon tetrachloride and (absolute) ethyl alcohol. Condensed ethyl silicate could be made simply by the reaction between silicon tetrachloride and alcohol containing 5 per cent. of water.

MR. MEERKAMP VAN EMBDEN replied that when choosing a binder the main consideration was the price paid for a certain amount of gelling silica. Another factor was convenience; ethyl silicate, with very few exceptions, was very adaptable and it was used on a large scale. However, why make a thing from gold if one could make it just as well from steel!—If poly-ethyl silicate were worse than tetra-silicate as a binder he would reject it, but if it were of the same quality and cheaper in price he preferred to use it. He did not see any need for making an ethyl silicate very pure, because the refractory powder with which it was mixed afterwards contained much more "dirt" than the most dirty poly-silicate.

MR. E. H. G. SARGENT (Astor Boisselier & Lawrence, Limited) asked why the author had to use hydrochloric acid to hydrolyze ethyl or sodium silicate. Why not use a strong organic acid, such as formic or oxalic acid, which would volatilize and leave no chloride in the system?

MR. MEERKAMP VAN EMBDEN confessed that the main reason why his company used ethyl silicate was that they were accustomed to it; the process was very adaptable. He recalled the graph he had shown to illustrate gelling time, and said that everything was controllable and no trouble whatever was experienced. When they had started to use sodium silicate they had run into several difficulties, and as they had not time to go into the problem carefully, bearing in mind that they already had a good process in use; there were so many other problems with production that they could not tackle them all, and the use of sodium silicate was not proceeded with.

Further, when using ethyl silicate, alcohol was formed which evaporated from the mould and the refractory remained clean; there was no contamination such as there was by sodium. When reclaiming mould material it was of importance to keep it clean and not to have accumulated contamination with sodium compounds which in the course of time would become a nuisance.

MR. A. DUNLOP (Foundry Services, Limited) confirmed the Author's remarks on founders' ability to regulate gelling of ethyl silicate; it was indeed readily controllable. He stated, however, that the gelling of sodium silicate and potassium silicate could be controlled if one knew how.

MR. MEERKAMP VAN EMBDEN said that was just what he did not know. He exhibited two bottles containing samples, one of which had gelled from ethyl silicate and the other from sodium silicate. The second one had a much whiter colour that the first, and the particle size was much larger. In the gelled ethyl silicate, the particles were more disperse, and in his opinion that sample was preferable to the whiter one.

Effect on Strength

MR. LISTER asked if the amount of available silica used could be related to the mould strength?

MR. MEERKAMP VAN EMBDEN replied that it could; the amount of silicate reacted was related to a certain amount of refractory.

MR. D. G. VOGTSCHMIDT (N.V. Philips' Gloeilampenfabriken) asked what amount of silicate the Author would use—10, 20 or 5 per cent.?

MR. MEERKAMP VAN EMBDEN replied that he would use about 1 or 2 per cent. of SiO_2 in the mould, not more than 2 per cent.

MR. LISTER asked about the amount in the liquid.

MR. MEERKAMP VAN EMBDEN said that in the stabilized liquid, which remained stable for several weeks, there was about 12 per cent. of SiO_2, and in the mould there was about 2 per cent.

A SPEAKER asked a question about the subsequent breaking up of moulds.

MR. MEERKAMP VAN EMBDEN said he had no figures but felt that this factor depended on the original water content. The material was baked at 900 deg. and it was very hard, but it was brittle.

THE PRESIDENT congratulated the Author on his excellent contribution and said how interesting it was to hear his views on investment. He expressed the thanks of the meeting to Mr. Meerkamp van Embden for his work.

SINCE LAUNCHING an intensive overseas sales drive earlier this year, it is announced that foreign orders for the Brush Group, Limited, have topped the £6,500,000 mark. Orders have come from such varied countries as Canada, India, Venezuela, Pakistan, Iran, Malaya, Liberia, Poland, and Ghana. The Brush Group is Britain's largest exporter of diesel-electric generating equipment, and its five main factories export more than three-quarters of their total production.

A NUMBER OF CONTRACTS for new equipment has been placed by British Transport Waterways. Thomas Smith & Son (Rodley), Limited, is to provide a Super 8 excavator; the Parsons Engineering Company, Limited, Southampton, six "Merganser" and three "Goosander" engines for narrow craft; Browne & Tawse Plant, Limited, West Gorton, Manchester, 13 Hymatic hydrovane portable compressors and hedge cutters, and Crone & Taylor (Engineering), Limited, St. Helens (Lancs), a "Big Walrus" loader.

Professional Photography

"How to get the most out of a works photograph" might be the lesson which foundrymen could take very much to heart from the annual exhibition* of professional photography organized by the Institute of British Photographers at the RBA Gallery, Suffolk Street, London, S.W.1 and held this year from September 6 to 17. In assessing a photograph to be used for publicity purposes, there should always be clear recognition that a print which records a foundry process or product in a spectacular fashion—either by clever use of lighting or shadow, catching an intent expression on an operator's face or by magnification—may not provide the best technical record of that subject, though it is possibly ideal for advertisement purposes. Nevertheless, the writer contends that it is nearly always possible to combine both objectives by really

"Foundry" photographs hung at this year's exhibition of professional photography in London.

(*a*) Measuring the pitch of the blade of a manganese-bronze propeller (courtesy, Bull's Metal & Marine, Limited). (*b*) Removing loose pieces from a core (courtesy, English Electric Company, Limited. Bradford). (*c*) Fettling an electric-arc melting furnace (courtesy, Lloyds (Burton), Limited). (*d*) Preparing an intricate mould ready for closing (courtesy, George Fletcher & Company, Limited).
Photograph (*a*) is by Maurice Broomfield and the others are by Walter Nurnberg, F.I.B.P., F.R.P.S.

Professional Photography

good photography, *i.e.*, provide a good technical record as well as a very pleasing picture. The illustrations on page 345 have been culled from the exhibition and show in some degree how it is possible to effect such a combination. Such a few examples, however, reduced in size as they are, for reproduction in the JOURNAL, do the whole show less than justice, and those works photographers who can do so should certainly make the trip to see the hundreds of pictures exhibited at these annual shows. At the very least they will be impressed and they may be inspired by the excellent photography of all types which is displayed each year.

Book Reviews

Investment Casting Engineering and Design Manual, by the Technical Committee of the (American) Investment Casting Institute, and published by the Institute from 27, East Monroe Street, Chicago 3, Illinois, USA; price $5.

As is the usual custom of American manufacturers, the investment founders through the medium of this manual, have thoroughly stated their case for the employment of investment castings. The manual outlines the advantages of the process and also its limitations, which when properly appreciated affect very considerably the price per casting.

The claims that were made some years ago by some US investment founders, as to dimensional accuracy and surface-finish obtainable, by the issue of this manual have been considerably modified and more factual data as to working tolerances and finishes are applied. By accepting wider tolerances the prices of castings are reduced, simply by a saving in the scrap produced content. Very useful tables are included to indicate the degree of accuracy to be expected on a large variety of shapes and sizes of castings. Special reference is made to aerofoil shapes and formulae are given for determining tolerances on turbine and compressor blades.

Useful notes are included to assist designers and enable them to appreciate some of the problems inherent in castings production, so that minor modifications can be introduced to simplify production, with consequent price reduction. A smaller selection of material specifications to illustrate what metals are utilized in investment casting is given. The heat-treatment, the testing procedure, and full release conditions of the materials cast are amply covered.

The most notable performance of the (American) Investment Casting Institute is that metal specifications have been drawn up by it to suit investment castings. Investment castings are often re-designed from stampings, forgings or machined parts; and in the absence of specific investment casting specifications, those applicable to wrought materials are stipulated. This is typical of British practice, as no organization is yet formed to deal with metal specifications, although the industry is now "at a talking point." Also of special interest is the standardization of investment-cast test-bars; agreement has been reached by US foundries on this profound subject, and an admirable arrangement is very well described.

In comparison with UK practice, this book does show a wider understanding among US founders of the necessity for common agreement as to the economic manufacture of castings. In the UK, founders of investment castings are still attempting to give designers whatever they care to put into a drawing, consequently prices are fairly high. This may be entirely due to the fact that the larger foundries in UK being "tied" to the aircraft-engine factories, have to attempt to manufacture castings of very intricate design in materials not designed for casting purposes. It is also a fact that tolerances of castings are closer generally in the UK than those described in the US. In the UK, metal specifications for investment-casting purposes are virtually non-existent, although a committee formed by the British Standards Institution is about to begin work on these. A final comment arising from perusal of this excellent book is that British practice is in no way behind that of the US save in the slowness of founders to advertise their wares, and to form themselves into a group for technical information exchange.

G. A. TOMKINSON.

Design of Die Castings, by Gustav Lieby. Published by the American Foundrymen's Society, Golf & Wolf Roads, Des Plaines, USA. Obtainable from the Penton Publishing Company, Limited, 2, Caxton Street, London, S.W.1; price £3 3s. including postage. (The author is at the Mahle Werk in Stuttgart, and was responsible for much of the magnesium pressure-die-castings production in Germany during the war.)

Herr Lieby has produced a book full of factual data which will be found to be of direct practical value to the casting designer and die-caster. The text of the book is advantageously brief, being well illustrated with copious diagrams and photographs. The discussions of design criteria are supported by tables of figures applicable to specific design problems.

After short chapters on the fundamental principles of die-casting and the alloys usually cast, the design aspect is introduced by a review of the physical properties of the alloys in relation to the functional design of castings. The selection of the correct shape from the point of view of function of the casting—and with regard to the construction and operation of the die required to produce it—is discussed in great detail. The design criteria necessary to ensure good die-casting practice are also dealt with very fully. Such aspects as wall thickness, rib design, radii required, holes, slots, inserts, etc., are covered in a quantitative manner. The remainder of the book is taken up with short sections on special aspects of the process, such as machining allowances, the conversion for die-casting of components previously produced by other methods, trimming and trimming dies. In conclusion there are two particularly useful chapters on dimensional tolerance and the economics of the method.

H. J. S.

Publications Received

Frederiks-Verk, 1756 to 1956.

This book was issued in connection with the bicentenary of what is now known as Kongelig Hofleverandör de Forenede Jernstöberier Aktieselskab—the largest stove-grate and light repetition foundry in Denmark. The book, which runs to nearly 100 pages and is well illustrated, is one of historical significance to the foundry industry as a whole. It is of course printed in Danish, but the illustrations themselves do much to overcome a reader's lack of knowledge of that language. One illustration, on page 79, shows a filigree fruit-dish, of which, the reviewer thinks, Mr. C. C. Booth, J.P., of Booth and Brookes, Limited, has a pattern. In its early days, the company was casting bronze cannons and really started as a foundry at Roskilde, in 1756. The publication is of the type which would grace the shelves of any library covering the history of engineering and metallurgy.

Hard Spots in Manganese-bronze Castings

Report from the British Bronze & Brass Ingot Manufacturers' Association

The Technical Committee of the British Bronze & Brass Ingot Manufacturers' Association has been investigating the cause of hard spots in manganese-bronze castings and the following is a report of their findings:—

Machining troubles due to the presence of hard spots are a periodically occurring defect in manganese-bronze castings. No completely satisfactory explanation of their cause has yet been formulated and it was with this objective in view that the Committee decided to investigate this foundry problem. When the opinion of founders was sought, some denied that they ever experienced any trouble from hard spots, and others considered that in the cases where it did occur, it was due to faulty admixture of the alloy. Other foundries still encountered the trouble in spite of paying great care to temperature conditions and mixing. Some theories as to the cause of this are as follow:—

(*a*) Use of iron high in carbon; (*b*) reduction of boron and silicon from the flux or furnace lining followed by the precipitation from the melt on cooling. These reactions are certainly possible, silicon pick-up from the furnace lining has been shown to occur in these alloys, and presumably boron could be reduced from a borate-containing-flux by zinc vapour, and (*c*) segregation of an iron-rich constituent from the melt on cooling. Under normal conditions this constituent is formed in manganese bronzes with a high-iron content, but this does not cause any trouble in machining. However, it is not impossible that under unusual conditions and perhaps in combination with the reduction listed in (*b*) this iron-rich constituent could be present in particles large enough and hard enough to cause machining troubles.

Technical Approach

The technical committee decided that the best method of approach to this problem would be to first of all, examine as many examples as possible from actual foundry practice. Surprisingly, in view of the supposed frequency of the trouble, it proved difficult to obtain samples in spite of personal requests to founder and advertisements in the technical Press. Batches of castings from only two sources were obtained. It was decided to concentrate on only one of these, because only one batch contained sufficient inclusions to make a detailed chemical analysis possible. Furthermore, the history of these castings was known in some detail. This history may be given briefly as follows:

The foundry had encountered the trouble using both secondary materials and, to a lesser degree, when using virgin alloy. The materials used were copper, zinc, aluminium and cupro-manganese and copper / aluminium / manganese / iron hardeners. None of these ingredients was magnetic, but on alloying them in the melt, a scum having a characteristic glistening appearance formed on the top of the metal, which on removal was found to be strongly magnetic. The hard spots in the castings were also strongly magnetic. The hard spots themselves were quite large, from 2- to 3-mm. square, with a hardness value ranging from 500 to 800 D.P.H.

Attempts to analyse the hard spots *in situ* spectrographically were not successful, recourse was had therefore to the separation of the inclusions by dissolution of the manganese-bronze with concentrated nitric acid in which the hard spots themselves were insoluble. The residue was then analysed by conventional spectrographic and chemical methods. The following percentage composition was revealed:—Cu 0.40; Mn 1.55; Cr 0.10; V 0.05; Al 0.50; W trace; Co 0.0; Si 9.18; B 0.20; Ti 0.30; C 0.53 (average of two results), and Fe remainder. (The manganese and silicon were determined chemically and the other elements spectrographically except carbon for which the combustion method was used.)

Examination under the microscope showed that the hard spots had a two-phase structure, the second phase consisting of fine, dispersed particles, probably a complex quaternary compound of iron, carbon, boron and silicon in a silico-ferrite matrix.

A compound of the above analysis could not have been molten at the temperatures attained in the preparation of this alloy, certainly less than 1,250 deg. C., whereas for example, FeSi does not melt until approximately 1,400 deg. C. The necessary fluidity to enable particles of the size of these hard spots to coalesce would only be attained in an electric furnace or the hotter zones of a blast-furnace. This conclusion would seem to point to the manganese containing "hardener" as the source of the troubles, a view which receives further support from the high-manganese content of the hard spots. Presumably the manganese or ferro-manganese used in the hardener contained the hard spots as a precipitated constituent and they remained substantially unaltered during the subsequent alloying process.

Observations

It would be premature to draw the conclusion that all "hard spots" in manganese-bronze are of this type or due to one cause, in fact there is some evidence to the contrary. During the investigation, a small experimental 7-lb. heat of manganese bronze was made up from high-grade rolled-brass scrap, manganese copper, hematite cast iron and 50/50 copper/aluminium alloy. This was melted without the use of flux in a silicon-carbide crucible. The resulting chill cast ingot did not reveal any hard spots when examined at low magnification nor was any trouble experienced during polishing. Examination at high magnification, however, revealed groups of fine inclusions. These were

Hard Spots in Manganese-bronze Castings

extracted by dissolving the sample in concentrated nitric acid. An 80 gm. sample produced a residue weighing 11 m.g. The residue was non-magnetic and subsequent spectrographic analysis showed that it consisted mainly of boron and silicon. A qualitative spectrographic analysis of the iron used in making up the alloy, and of the crucible showed that both contained small amounts of boron. This would seem to indicate that there is scope for further investigation of this problem.

The secretaries of the Association—Heathcote and Coleman, 69 Harborne Road, Edgbaston, Birmingham, 15, would welcome the receipt of samples of hard shots for further investigation.

Consumable-electrode Process of Vacuum Remelting

According to a communication issued by Allegheny Ludlum Steel Corporation, negotiations are now under way for the sale of a consumable-electrode vacuum melting process developed by the Corporation for production of so-called "super-alloys" for high-temperature and high-stress applications in jet aircraft and engines, turbines and atomic reactors.

The production problems caused by the appreciable quantities of titanium and aluminium which these alloys contain led in the first place to the use of induction vacuum melting. Another approach to the problem has been to adapt the consumable-electrode vacuum melting process which is used commercially to melt such metals as titanium, zirconium and molybdenum.

The consumable-electrode process consists of making wrought or cast electrodes of an alloyed, predetermined composition from a large, production-size, electric-furnace air melt and then remelting these electrodes under vacuum by arc melting in a water-cooled, copper crucible. Allegheny Ludlum first announced its commercial development of the consumable-electrode vacuum remelting furnace in October, 1955, with the opening of a new department at Watervliet, New York, for the production of 112 tons per month of high-temperature super-alloys. The department has been expanded rapidly, with the result that the company can now produce 890 tons per month of these metals in ingot sizes up to 26-in. dia. weighing up to 5 tons.

Advantages of the Process

Results show that consumable-electrode vacuum remelting offers the following advantages over conventionally melted super-alloys: (1) Extreme cleanliness; (2) lower gas contents obtained through the removal of varying amounts of oxygen, hydrogen, and nitrogen; (3) virtual freedom from segregation in large ingot and billet sections obtained with rapid solidification rates; (4) chemical homogeneity, possible through the use of an alloyed electrode of predetermined composition and the double-melt principle; (5) improvement in hot and cold workability; (6) improvement of certain high-temperature mechanical properties.

With regard to costs, the communication states that it is difficult to predict whether induction vacuum or consumable-electrode vacuum melting will be more economical as the size of furnaces and ingots increases. Capital investment, maintenance, upkeep and labour costs will be important factors and will undoubtedly vary from shop to shop. The extent to which each of these melting procedures can be made automatic also will have a significant effect on costs.

Methods Compared

It is realized that obtaining ultra-high-purity metals and alloys may be more difficult with consumable-electrode than by induction vacuum melting due to the nature of the two processes. However, it will be a combination of the properties of the final end product plus the economics which will determine the extent of purity required. One possible disadvantage of consumable-electrode melting is that the pool stays molten for a relatively short length of time, thereby limiting the time allowed for degasification and deoxidation. However, factors which tend to counterbalance this are the higher temperature involved and the fact that the melting in a cold metal mould eliminates the possibility of contamination by refractory materials to which an induction vacuum melt is exposed. In addition, the progressive melting and vertical solidification afford the opportunity to levitate exogenous inclusions due to their lower specific gravity.

One means of producing high-purity alloys in large ingot sizes and quantities would be by combining the two processes—that is, by casting electrodes from an induction vacuum melt and subsequently remelting under vacuum by the consumable-electrode process. It is intended to explore this technique in the near future wherein cast electrodes weighing 9 cwt. will be produced from an induction vacuum melting furnace and remelted.

Shipbuilders' Modesty

"British shipbuilders tend to hide their light under a bushel so far as modernization and plans for the future are concerned. I think it is time we spoke up and rubbed in what we are trying to do to keep British shipbuilding ahead of everyone else," said Mr. P. Denham Christie, managing director of Swan, Hunter, & Wigham Richardson, Limited, recently.

Mr. Christie said that for a comparatively small and internationally competitive industry huge sums were being spent in Britain in keeping shipbuilding not only abreast but ahead of other shipbuilding nations.

It showed great faith in the future and he believed that shipbuilding on the Tyne was likely to prosper for many years so long as everyone employed in it was keen to make it the success it should be.

Mr. CHARLES H. ATWOOD has been appointed president of the Union Carbide Caribe, Inc., a subsidiary of the Union Carbide Corporation.

Patent "Pigs" of the 'Eighteen-thirties

By T. R. Harris

The techniques employed in the production of pig-iron have undergone considerable change during the last 200 years. One of the outstanding ironmasters responsible for improved methods in the first half of the last century was George Crane, of the Yniscedwyn Ironworks.

In 1837 he patented a process for producing a superior type of pig, some details of his process and the success attending it can be obtained from the perusal of his correspondence with an ironfounder with whom he did business.

Fortunately, some of Crane's letters have survived. From one dated April 20, 1837, it is learnt that he was "from home attending to the affairs of my Patent in London," he continued "I have just directed one of our local papers, *The Cambrian*, to you as that paper contains the first public notice of my success in the application of stone coal to the smelting of ironstone. You must know from experience what an injurious effect hot blast has upon the strength of iron when smelted with the coke or the coal of the bituminous kind, one of the most remarkable things connected with this experiment is the contrary effect upon the quality of the iron when anthracite or stone coal is the fuel."

Successful Experiments

A week later Crane reported that he had succeeded in his experiments with smelting iron-ore with stone coal with regard to quality, quantity and economy.

In December, 1837, Crane wrote, "From the favourable reports which we are getting of the quality of our pigs particularly for foundry purposes we had hoped ere this to have had the pleasure of your additional orders." He continues, "This post, one of the very first founders in Staffordshire thus wrote us 'your Patent iron fully equals its representation which you made to us of its quality, both for great strength and at high temperature great fluidity. We shall be glad to make a suitable arrangement with you for a regular supply.'"

At this time Crane had "perhaps 200 tons in stock" and stated "we shall value your order for any portion of it. In three to four months we hope to be making 250 tons weekly. It is our wish to form a few respectable and regular connections for pigs to take off our make, it would give us pleasure to find you one of them."

The increased demand for the patent pigs of the Yniscedwyn ironworks is reflected in some letters of 1838. In March of that year, Crane wrote "we much regret we cannot now accept any orders for No. 1 Patent pig-iron and the pressure for our iron is so great that it will not be in our power to execute any order for the next two months, after which we hope to increase our make and shall then be happy to execute your orders at the time's prices."

By August the situation was somewhat eased and Crane informed his correspondent, "We believe we promised to advise you when our arrangements were sufficiently complete to enable us to offer you a supply of foundry iron with regularity, we have now not 50 tons in stock, but we are now making a large quantity weekly, we beg to say that it will give us pleasure to put ourselves now upon terms of regular communication with you for iron. You are doubtless aware that the demand is very brisk."

In February, 1839, Crane enquires "How are you now for foundry iron? Our sales of pigs within the last 10 days have exceeded 500 tons and our stock is now getting very low. . . . You will find if you were to remelt with hot blast and anthracite all kinds of iron improve as to strength and fluidity by that process."

Other ironmasters were interested in Crane's process and applied to him for leave to produce pigs by this means. One of the companies which were anxious to adopt the patent process was the Ystalyfern Iron Company. Answering an enquiry as to the respectability of this company, who had ordered a steam engine from Crane's correspondent, he replied, "I am myself not upon friendly terms with them as I have refused to grant them a licence, a legal discussion must arise betwixt us the moment they may start."

In May, Crane reports "We continue to remelt entirely with anthracite and which fuel we find much advantage in using, 7 cwt. of iron is our regular charge upon 1 cwt. of calcined anthracite and when we are remelting all No. 1 the coal will carry a still larger burden."

By September, 1840, the furnace which was used for making "all anthracite has lately been out of blast for repairs, but is now fully at work again, however the present accumulation of previous orders may prevent your turn arriving for about three weeks, at the end of that time we hope to be able to supply you with iron smelted with anthracite as promptly as we may be favoured with your orders . . . of iron melted with a half anthracite and a half coke we may have from 1 to 200 tons each of both No. 1 and No. 2 on the wharf."

Changeover Completed

In August, 1843, Crane stated that they had "now finally ceased to use anything but anthracite only upon the whole of our blast furnaces at these works. That our quality stands high will be best proved by the fact that we have not had, during the whole of the present year, nor have we now 300 tons of iron in stock unsold. . . . We have placed the charge of our interest in the West in the hands of Messrs. Nash, Cole and Ellan of Bristol. . . . One-third of our stone pig with two-thirds Scotch would form not a bad metal."

By May, 1844, there were four furnaces in blast at Yniscedwyn "*all* upon anthracite" and a fifth

Patent "Pigs" of the 'Eighteen-thirties

was building, "the whole make last week was 231 tons 5 cwt. 2 qrs. 23 lb."

The appearance of anthracite iron varied from that previously produced and the following extract speaks for itself. Dealing with this type of iron the writer continues, "We find it, in remelting, to run extremely fluid and at the same time it will work very large quantities of old castings. Its great strength you will find in breaking the pigs. We expect also that the waste will be found to be less than in any other iron. With all these good qualities we find a great difficulty in obtaining it with a smooth face, indeed the larger the quantity of anthracite used in smelting the less chance we have of a smooth face in the pig, so that in anthracite iron it will be necessary to fix a new standard for No. 1 Iron, it must be from its fracture and not as at present from its face."

European Steel Production

Further advances in steel production in the European Coal and Steel Community are recorded for August. Provisional figures published by the High Authority's Statistics Division show a total of 4,876,000 *tonnes* for August, and production for January to August is 39,042,000 *tonnes* compared with 37,252,000 *tonnes* for the corresponding period last year—an increase of 4.8 per cent.

ECSC pig-iron and ferro-alloys output also continued to rise, reaching 3,780,000 *tonnes* last month and 29,592,000 *tonnes* for the eight months of 1957 —an increase of 3.1 per cent. over the corresponding period of 1956.

Steel production by countries for August (with the figures for the eight months of 1957 given in parentheses) are as follows (in *tonnes*):—Germany, 2,122,000 (16,057,000); Saar, 297,000 (2,290,000); Belgium, 542,000 (4,031,000); France, 1,010,000 (9,127,000); Italy, 525,000 (4,419,000); Luxembourg, 286,000 (2,341,000); Netherlands, 94,000 (777,000).

Conference on Pulverized Fuel

With the purpose of bringing up to date a review of developments in pulverized fuel firing a conference has been arranged by the Institute of Fuel, to be held at the Institution of Civil Engineers, Great George Street, London, S.W.1, on November 27 and 28. The intention is also to set the subject in focus against the general background of development in all fuels, including nuclear fuels. The first conference on the subject was held 10 years ago at Harrogate.

There will be four sessions: the first two—after an opening paper by Dr. G. H. Daniel, Under-Secretary to the Ministry of Power, on energy supplies in the United Kingdom and overseas, with special reference to pulverized fuel practice—will deal with research work on pulverized fuel, fundamental and applied; the third with pulverized-fuel practice in the UK; and the last with practice in Australia, France and Belgium, Germany, and the United States. Details can be obtained from the secretary, the Institute of Fuel, 18, Devonshire Street, Portland Place, London, W.1.

MAJ. M. J. WEBB has been appointed a director of Midland Industries, Limited.

Girls in Industry

"Whether we like it or not, we are depending more and more on our engineering industry. If we can make things better than Germany or Japan, then we are winning; if we do not—then we are losing," said Mr. A. J. Nicholas, managing director of South Wales Switchgear, Limited, on September 4. He was addressing more than 100 Glamorgan and Monmouthshire grammar school boys and girls at the closing ceremony and discussion to mark the end of five weekly vacation courses arranged by the company.

There was no point in youth entering industry without knowing exactly where it was going, said Mr. Nicholas. By having a preview of the industry, the firm was more likely to get the people who fitted the job rather than the part misfits—one of the evils of the past. What South Wales Switchgear had started some years ago, had now been extended throughout Britain.

There was every opportunity for girls to come into the industry, and there was nothing to prevent a girl student apprentice from being at least equal to her boy neighbour and have the advantages of attending part-time colleges, and ultimately to attain the Higher National Certificate in engineering. Britain must take positive steps to break down the tradition which had tended to keep women away from the professional engineering status.

Iron and Steel Production Up

Output of both iron and steel continues to run well above last year's levels, according to the August figures issued by the Iron and Steel Board. The increase in the output of pig-iron has so improved the supply position that forward contracts for imported scrap and pig-iron have been reduced.

Steel production in August was at the rate of 373,400 tons a week—10 per cent. higher than in the same month of last year, and the production of pig-iron shows an even larger proportionate rise over the August, 1956, figure.

Comparative Figures of Iron and Steel Production (gross tons)

Period.	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
1957—June	274,600	14,282,008	418,700	21,771,000
July	263,400	13,695,000	362,500	18,848,000
August ..	272,500	14,169,000	373,400	19,417,000
1956—June	239,600	12,459,000	379,700	19,744,000
July	240,300	12,495,000	326,400	16,971,000
August ..	235,900	12,265,000	340,600	17,712,000

Offer for Kay (Engineers) Shares

Further details have now been announced of the offer to purchase all the issued 1,320,000 ordinary 2s. 6d. shares of Kay & Company (Engineers), Limited, Bolton, at a price of 20s. cash per share, by the Charterhouse Industrial Development Company, Limited, London, E.C.4. The offer is conditional upon acceptance by holders of 75 per cent. of the shares on or before September 27. Charterhouse may extend the period, but not later than October 31. Acceptance of the offer is recommended by the Kay directors.

Company News

BABCOCK & WILCOX, LIMITED, London, E.C.4—The interim dividend on the £7,524,398 ordinary capital is 7 per cent.

BRITISH ALUMINIUM COMPANY, LIMITED, London, S.W.1—Stockholders have subscribed for 80 per cent. of the 2,000,000 £1 ordinary shares offered to them at 58s. per share.

HEAD, WRIGHTSON & COMPANY, LIMITED, engineers and ironfounders, of Thornaby-on-Tees—Treasury consent has been obtained for the capitalization of £590,625 of revenue reserve and the distribution of one 5s. ordinary share for each 10s. nominal of ordinary capital held on September 11.

JOHN THOMPSON, LIMITED, boilermakers, general engineers, and ironfounders, etc., of Wolverhampton—The interim ordinary dividend for 1957 is maintained at 10 per cent. on the capital as increased by a one-for-seven rights issue. For 1956 a 15 per cent. final was paid on the smaller capital.

GLENFIELD & KENNEDY HOLDINGS, LIMITED, valve manufacturers, hydraulic engineers, etc., of Kilmarnock—Applications totalling £3,593,800 have been received for the offer of £1,600,000 5¼ per cent. convertible unsecured loan stock. Applications for up to 3,500 shares are being allocated in full, the remainder on a proportionate basis up to 88,500 for applications of 250,000 shares.

ACROW (ENGINEERS), LIMITED—The final dividend is 17½ per cent., making 37½ per cent. on the £400,000 ordinary capital as increased by a one-for-seven scrip issue, against the equivalent of 30⅝ per cent. and a forecast of not less than 35 per cent. Group trading profits rose to a record £604,772 (£537,501). Net profits were little changed at £256,804 (£253,631).

C. E. HARPER AIRCRAFT COMPANY, LIMITED, Clyst Honiton (Devon)—An interim dividend of 10 per cent. on the capital as increased by the issue of 984,620 1s. shares against the acquisition of the Electric Screw, Limited, and by an issue of 1,173,900 1s. shares against the acquisition of the Baldwin Instrument Company, Limited, is announced. For the previous 18 months an interim of 12½ per cent. was followed by a second interim of 8⅓ per cent. and a final of 4⅙ per cent., all of which were paid on the smaller capital.

TRIPLEX FOUNDRY, LIMITED, Tipton (Staffs)—Referring to the acquisition in April of Henry Harrison & Sons, Limited, padlock manufacturers, of Willenhall (Staffs), and the impending purchase of Vowles Aluminium Foundry Company, Limited, West Bromwich, the chairman, Mr. W. H. L. Harrison, says that the combined profits of these two companies have, for several years, exceeded £60,000 a year. Their acquisition cost £250,000, but it is hoped that next year will see the company back on a profit-earning basis. As a result of the strain on the group's liquid resources, it will be necessary to raise further capital at the appropriate time.

US Lead and Zinc Imports

The US Tariff Commission is to be petitioned by the Emergency Lead-Zinc Committee for the highest possible import duties, import quotas, and other relief possible under the law.

The maximum duties the commission could recommend would be 2.55 cents per pound for pig lead, compared with the present 1.0625 cents, and 2.1 cents for slab zinc now at 0.7 cent.

New Patents

(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 2s. 6d.)

778,005. Hills McCanna Company, 3025 North Western Avenue, Chicago, Illinois, U.S.A.

An improved method of making precise and complex-shaped cored passageways in metal casings, with special reference to uniformly-smooth and accurately-cored passageways in magnesium and aluminium-alloy castings.

778,039.—Degerfors Jarnverks AB., Degerfors, Sweden.

This invention is claimed to make it possible to produce, in a simple manner, rammed-in "hot tops" converging upwards, by using a collapsible or demountable template. Such hot tops can be made very quickly and with a good insulating effect.

778,057. Julien Raick, 87, Avenue Brugman, Brussels, Belgium.

A method of operating blast furnaces. It has particular reference to specific and calculable methods of utilizing hydrocarbon materials as the source of the heat and reducing power required for smelting iron or other metallic oxides.

778,398. Glacier Metal Company, Limited, 368, Ealing Road, Alperton, Wembley, Middx.

A method of making a bearing or bearing material of the kind in which iron, or an alloy of iron and lead (or a lead alloy), are combined under heat-treatment in proportions containing between 10 and 50 per cent of lead with the inclusion of a proportion of sulphur.

Swan, Hunter Offer to Subsidiary

An offer to acquire the ordinary and preference shares of its subsidiary, the Wallsend Slipway & Engineering Company, Limited, at present held by minority shareholders, has been made by Swan, Hunter & Wigham Richardson, Limited. The shares consist of 205,430 of the issued ordinary capital of 596,120 shares of 10s. each, fully paid, and 56,340 of the 84,000 fully paid 6 per cent. cumulative preference shares of £1 each.

The offer is: In exchange for each five ordinary there will be issued nine ordinary shares of £1 each in Swan, Hunter, while holders of the 6 per cent. cumulative preference shares will receive one 6 per cent. cumulative preference share of £1 in Swan, Hunter, together with a cash payment of 2s. The offer remains open until September 27.

Raine & Company Sold by ISHRA

It is announced by the Iron and Steel Holding and Realization Agency that the sale has been completed to Cyril Kieft & Company, Limited, makers of heavy edge tools, Wolverhampton, and Close Bros., Limited, of the agency's holding of the entire capital of Raine & Company, Limited, iron and steel manufacturers, of Newcastle-upon-Tyne.

The agency's investment in Raine & Company was £393,232 represented by compensation under the Iron and Steel Act, 1949.

THE RAILWAY WAGON construction and repair business of Thomas Hunter, Limited, Rugby, has been taken over by William Rigley & Sons, Limited, Nottingham. Mr. Thomas Hunter founded the business in 1869 and was succeeded by his son, who later formed a limited company.

News in Brief

ORDERS worth about £660,000 to supply 560 rail wagons and track materials to the Sudan have recently been obtained by Robert Hudson, Limited, Leeds.

EMPLOYEES of the Greenside Foundry, Limited, near Sheffield, staged their first flower and vegetable show on Saturday, September 7, when the silver cup for most points was won by Mr. W. D. Moorhouse.

THE Federation of Light Metal Smelters announces that its members' average selling prices for July, calculated to the nearest 10s., were:—LM1, £157 per ton; LM2, £158; LM4, £181 10s.; LM6, £201 10s.

HATTERSLEY BROTHERS, LIMITED, Mexborough, Yorks, will be displaying their Vulcan and Vesta gas-fired boilers at the Gas Sales and Service Conference, to be held at Harrogate from October 1 to 3.

WICKMAN, LIMITED, announce their appointment as sole agents in the United Kingdom for the range of microfinishing machines manufactured by—Maschinenfabrik Ernst Thielenhaus, Wuppertal-Barmen, Germany.

RAW OIL from the Saharan wells of Edjelé, Algeria, will be pumped through a pipeline designed and operated by "Trapsa," a firm created for the purpose, in which the Royal Dutch Shell Group will participate.

IN COLLABORATION with the Northampton College of Advanced Technology, the Central London section of the London Productivity Council is organizing a production exhibition and work-study week from November 18 to 22.

A LORRY DRIVER, Mr. W. H. CARR, was fined £30 with three guineas costs at Newcastle for stealing two bags of brass ingots, total value £9 4s. 3d. from the Railway Bank works of R. Blackett Charlton, Limited, Newcastle, on September 2 and 3.

LAST WEEK Bradford Fire Brigade was summoned to the premises of Low Moor Alloy Steel Works, Limited, where a fire had been caused by hot embers from a furnace igniting oil. Damage was confined to three electrode arm ropes, which were destroyed.

HUSQVARNA VAPENFABRIKS AB, manufacturers of heating and household articles, Sweden, plan a considerable output of their sewing machines. It is proposed to instal automatic plant which should enable output to be raised by 50 per cent. without increasing the labour force.

A REPORT on the German market for industrial trucks and trolleys, manufactured in the UK, has been prepared by the Export Services Branch of the Board of Trade. Persons interested in this detailed survey should write to the Branch at Lacon House, Theobalds Road, London, W.C.1.

ERIKSBERGS MEKANISKA VERKSTAD, Gothenburg, Sweden, have obtained an order from the American oil company, Socony Mobiloil, for five super tankers each of 48,600 tons gross. The value of the order exceeds 225,000,000 (Swedish crowns); the ships are to be delivered between 1960 and 1963.

WEST MIDLANDS ADVISORY COUNCIL OF TECHNICAL, COMMERCIAL AND ART EDUCATION announce that there will be a course of five weekly evening lectures on vitreous enamelling at Wednesbury County Technical College commencing this autumn. Further details may be obtained from the principal.

NORRIS WARMING (CANADA), LIMITED, 640, Cathcart Street, Montreal, have been appointed the sole agent in Canada for Tornado fan-engineering equipment manufactured by Keith Blackman, Limited. The office will be under the control of Mr. Norman Shergold who has extensive experience in this field.

THE DUNDEE FACTORY for the treatment of machinery and tools with a new friction-eliminating process patented by an Edinburgh inventor, Mr. John McGregor, is now in operation. The Scottish company, Progregs, Limited, has had offers from firms in Europe, America, India, and Japan to open plants and act as agents.

TOTAL pig-lead (minimum content 99.95 per cent.) production in OEEC producer countries (Austria, Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, the United Kingdom and Sweden, as well as in Morocco and Tunisia) amounted to 42,737 *tonnes* in July as compared with 45,640 *tonnes* in the previous month.

A NEW STEEL-MELTING FURNACE is to be put into operation at Stewarts and Lloyds' Clydesdale Steelworks, Mossend, Lanarkshire, at the beginning of next month. The new furnace, of 60 tons capacity, will give a yield of about 1,200 tons of steel per week. This will be the fifth furnace to be put into operation at these works.

A COURSE ON INDUSTRIAL AND FACTORY LAW will be held under the auspices of the Industrial Welfare Society from October 22 to 24 at Robert Hyde House, 48, Bryanston Square, London, W.1. Mr. Harry Samuels, M.A., will be the lecturer. Further details can be obtained from the secretary of the Society at the above address.

AT the fifth European Machine Tool Exhibition currently being held at Hanover a number of diecasting machines will be on view at the Triulzi stand (No. 7315 hall No. 7) including one vertical-injection cold-chamber machine, a hot-chamber machine and a new oil-hydraulic, self-contained fully-automatic model, displayed for the first time.

PRELIMINARY WORK has now commenced at the Hunterston site for the atomic-energy station that is being built by the General Electric Company, Limited, for the South of Scotland Electricity Board. Associated with the GEC are Simon-Carves, Limited, the Motherwell Bridge and Engineering Company, Limited, and John Mowlem (Scotland), Limited.

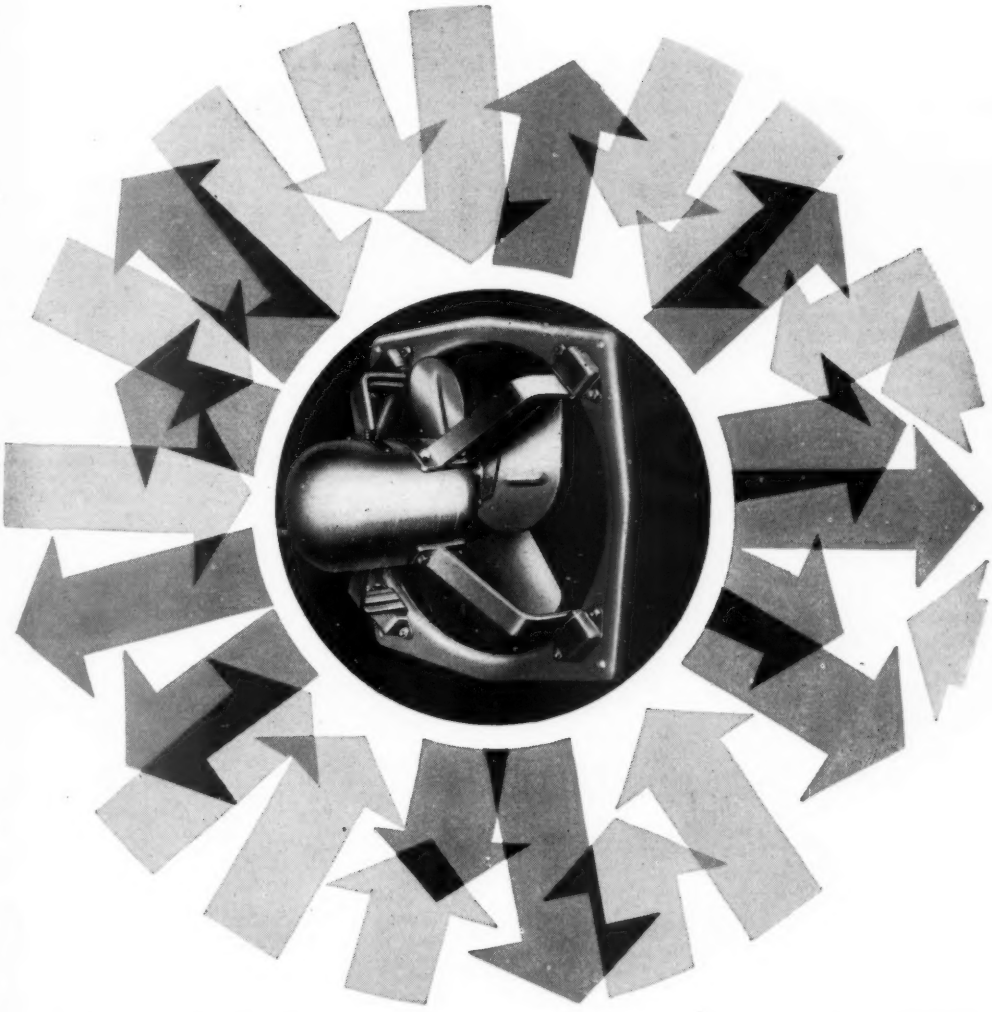
THE EXTENSIVE bus-fleet replacement programmes which are being undertaken by British Municipalities is reflected in the vehicle output figures of Leyland Motors, Limited, for the first eight months of this year. Total output, with the inclusion of the August returns, is 17 per cent. higher this year as compared with the corresponding period in 1956.

A MAJOR STEP in the process of automation was taken by Lec Refrigeration, Limited, Bognor Regis, during the factory annual holiday. When employees returned after their fortnight's break they found the first moving conveyor assembly line had come into being. This necessitated a great deal of electrical work and the relaying of considerable areas of the factory floor.

AT THE SIXTH ANNUAL EXHIBITION of the Works and Social Club (horticultural section) of F. Parramore & Sons (1924) Limited, ironfounders, Chapeltown, Sheffield, on Saturday, September 7, the president's trophy, given by Mr. Ernest Parramore, was won by Mr. H. Haslam who altogether won three trophies, including the one given to the society by himself.

A FACTORY is to be built at East Kilbride for J. H. Carruthers & Company, Limited, crane and pump manufacturers, of Polmadie, Parkhead and Lambhill, Glasgow. It will be ready to go into production next

(*Continued on page* 354)



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The General Electric Company Limited, Magnet House, Kingsway, London, W.C.2.

News in Brief

(*Continued from page* 352)

year. The Cincinnati Shaper Company, of Ohio, who have also leased a factory site at East Kilbride, are now planning to have the factory built by a Glasgow firm.

IT IS ANNOUNCED by the Exports Services Branch of the Board of Trade that the company of Kromhout Motoren Fabriek D. Goedkoop Jr.N.V. at Amsterdam, reached the record turnover of £2,123,590, an increase of 10.8 per cent. on the figure for 1955. The company's production includes marine and static diesel-engines; traction engines; diesel-electric units; chassis; lorries, and trailers.

AN OUTBREAK OF FIRE last week at the premises of Bradley & Craven, Limited, brick-machinery manufacturers, who operate a foundry department at Westgate Common, Wakefield, destroyed a pattern-store, causing the loss of thousands of wooden patterns in store. Urgently needed fresh patterns are being made in their own shops by master patternmakers, and production will not be seriously interrupted.

TOTAL REFINED ZINC production for OEEC producer countries (Austria, Belgium and the Belgian Congo, France, Germany, Italy, Netherlands, Norway, and the United Kingdom) amounted to 67,246 *tonnes* in July, compared with 68,038 *tonnes* in the previous month. The July breakdown into qualities was:—High-grade and special high-grade zinc (at least 99.95 per cent. zinc content), 28,038 *tonnes*; others (g.o.b., debased), 39,208 *tonnes*.

TO EXPEDITE DELIVERY of a consignment of furnaces to Holland, and to economize on costs, Wild-Barfield Electric Furnaces, Limited, sent the equipment from factory to user by road, the vehicle crossing by ferry from Tilbury. By this means, no time was lost in transhipment handling and the cost of crates and packing materials was obviated. The furnaces form part of a new heat-treatment installation which includes gas-carburizing equipment.

TWENTY-FIVE SUNDERLAND SEAPLANES left at Wig Bay, on Loch Ryan, are being broken up by International Alloys, Limited, for aluminium ingots. An American firm has purchased 75 engines and another firm 27. By the end of the month there will be nothing left either of aircraft or ancillary works, apart from the hangars and the slipway. The base closed down on September 11, when the last Sunderland left for Singapore.

Walker, Crosweller & Company, Limited, Cheltenham, have announced the appointment of Mr. WILLIAM FIDDES as special technical representative for their "Arkon" products, which include gas-flow recorders, pressure and vacuum recorders, remote-reading instruments and flow indicators. Mr. Fiddes, an Australian, was trained at Broken Hill Proprietary Steelworks Company, Limited, at Newcastle, New South Wales, Australia.

SIX MILL HOUSINGS which have been in use for 18 years at Ebbw Vale, have been converted by the Davy & United Engineering Company, Limited, Sheffield, for use at the Cookley works of Richard Thomas & Baldwins, Limited. The six housings, which each weigh about 60 tons, were originally removed from the old five-stand-tandem cold strip mill at Ebbw Vale which was recently replaced by a new Davy-United five-stand tandem.

PLANS FOR A GASIFICATION PLANT that would produce 30,000,000 cub. ft. of gas a day—the biggest plant of its kind in Britain—are being considered by the Scottish Gas Board, it was announced in Glasgow on September 6 by Mr. David Renton, Parliamentary Secretary to the Ministry of Power. The plant was planned for Westfield (East Fife) where the National Coal Board was developing an opencast mine and a gas grid crossing the Firth of Forth would be needed to link the plant with the supply area.

THE SHEFFIELD FIRM of William Jessop & Sons, Limited, announced at the Farnborough Exhibition held recently that, in addition to melting the largest titanium ingots in Europe, they are using a revolutionary technique in steelmaking by which they are now producing steel melted in vacuum as a bulk production process. It is claimed that throughout Europe this has so far been done only on the laboratory scale. The company say they are now regularly making ingots weighing nearly two tons in vacuum-melted steel and will shortly be able to produce even larger ingots.

BRUSH GROUP, LIMITED, has formed a subsidiary company—National Free Piston Power, Limited—for marketing at home and overseas free-piston gasifyers, manufactured by the National Gas & Oil Engine Company, Limited, under Pescara/SEME/Muntz licence. Mr. Donald Robson, formerly of Alan Muntz & Company, Limited, has been appointed executive director of the new company in which capacity he will be responsible to Mr. B. R. Cant, general manager of the National Gas & Oil Engine Company. Other directors of the company are Mr. Ian T. Morrow, chairman (managing director of the Brush Group), Mr. C. F. Barnard and Mr. F. Warhurst.

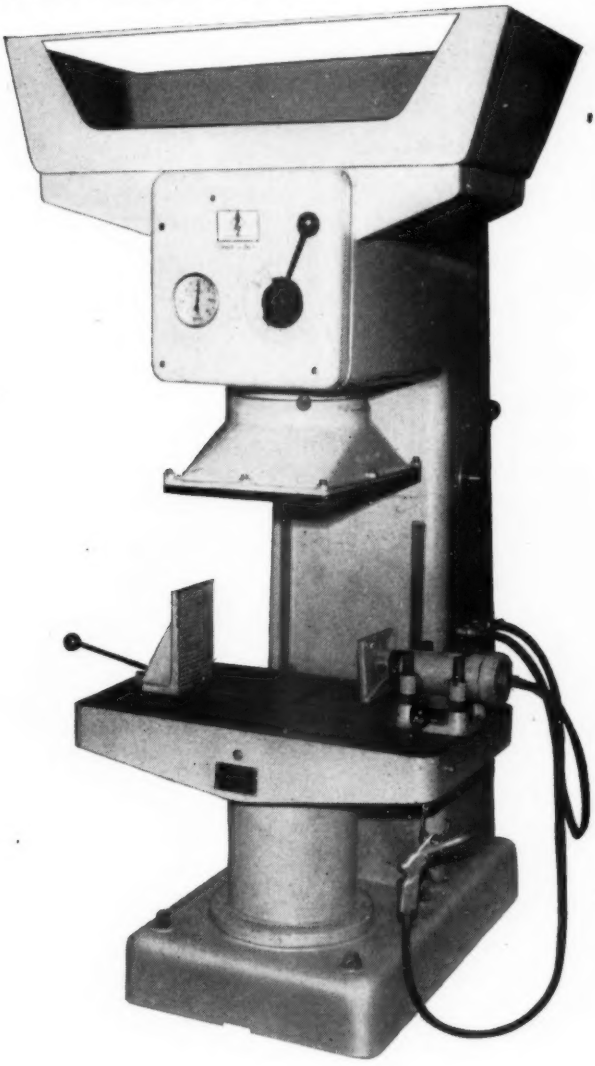
A TRAINING SCHOOL will be housed in the new head offices of Honeywell-Brown, Limited, which are to be opened at Greenford in June, 1958. In a fully-equipped lecture theatre and laboratory, employees and users from all over Europe will be taught how to apply modern instrumentation to industrial processes and heating and air-conditioning systems. The school will also provide courses on micro switching. Another feature is the multi-purpose telephone receivers which will combine outside call and internal facilities in one instrument. An outside caller will be able to hold a conference with up to four inside speakers, speaking from their own desks. This dual purpose facility, the first of its kind in this country, has been made possible by special arrangement with the GPO.

THE INSTITUTION OF MECHANICAL ENGINEERS is organizing an international conference on "Lubrication and Wear," which will be held from October 1 to 3. In addition to the technical sessions to be held at Great Smith Street, and at the Federation of British Industries, Tothill Street, Westminster, London, S.W.1, there will be a cocktail party at the Hyde Park Hotel, on September 30, and a number of conference visits and sightseeing tours. The latter include a whole-day visit to Cambridge, and among the firms on the list of half-day visits are: Associated Electrical Industries, Limited, Aldermaston; Ford Motor Company, Limited, Dagenham; Glacier Metal Company, Limited, Alperton; and Monsanto Chemicals, Limited. Further details may be obtained by writing to the secretary of the Institution at 1, Birdcage Walk, Westminster, London S.W.1.

Commonwealth Mining and Metallurgical Congress

The sixth Commonwealth Mining and Metallurgical Congress began in Vancouver, BC, on September 8. The congress ends in Halifax, Nova Scotia, on October 9. Many important mines, metallurgical plants, and refineries are being visited, either by air, by rail, or by air and rail combined.

HANSBERG Coreshooters



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Personal

Mr. A. E. PEARCE has been appointed an additional director of Qualcast, Limited.

Mr. E. JULIAN PODE has been appointed a director of Guest Keen & Nettlefolds, Limited.

Mr. F. HORTON has been appointed foundry manager of George Richards & Company, Limited, Broadheath, near Manchester.

Sir JAMES REID YOUNG has been appointed chairman of International Combustion (Holdings) Limited in place of Mr. G. R. T. TAYLOR, who has retired as chairman but remains on the board.

Mr. A. GILCHRIST, general manager of the North British Engine Works, Glasgow, of Barclay, Curle & Company, Limited, shipbuilders and engineers, has been appointed a director of the company.

Mr. R. W. LATHAM, chief training officer of Rubery Owen and Company, Limited, Darlaston, has been appointed manager of the light-axle-case department. Mr. Latham is chairman of the Walsall and district Productivity Committee.

Mr. ROBERT L. CANNELL, who was formerly a senior education officer in industry working with the central personnel services department of the English Electric group of companies, has been appointed vice-principal of Loughborough College of Technology.

Mr. W. B. FENWICK, deputy works manager of A. Reyrolle & Company, Limited, manufacturing electrical engineers, of Hebburn (Co. Durham), since last year, has been appointed works manager. He succeeds Mr. T. McCulloch, who died recently. He was formerly East Midlands area manager and returned to Hebburn as deputy works manager in 1956.

Among those present at a reunion of retired employees of W. & T. Avery, Limited, of Smethwick Soho Foundry, was Mr. CAMERON MCGREGOR former technical manager. He was particularly interested to see among the machines and equipment a new automatic indication mechanism, because the forerunner of the machine was among the 48 patents he took out while in the service of the company with whom he spent 50 years.

Mr. BIREN MUKERJEE, a senior director of Marshall, Sons & Company (India) Limited, engineers, a subsidiary of the Gainsborough firm, has presented a cup to Gainsborough Rowing Club to be offered for competition in a new event of single sculling on the Trent at Easter. Mr. Mukerjee served his engineering apprenticeship in Gainsborough 25 years ago and was then an active member of the Rowing Club. Mr. N. W. KEYWORTH, a director of the firm's India office who was a colleague of Mr. Mukerjee in India for over 20 years, presented the cup in Gainsborough to Mr. Edmund Dawber, 82-year-old president of the Rowing Club.

Sheffield's 32nd Master Cutler will be Sir FREDERICK PICKWORTH, chairman of the English Steel Corporation, Limited. He was nominated on September 9 and will be installed next month in succession to Sir PETER ROBERTS, M.P. Sir Frederick, who was knighted in this year's Birthday Honours, is also chairman of Darlington Forge, Limited, the English Drilling Equipment Company, Limited, the English Steel Castings Corporation, Limited, the English Steel Forge & Engineering Corporation, Limited, the English Steel Rolling Mills Corporation, Limited, the English Steel Spring Corporation, Limited, the English Steel Tool Corporation, Limited, Security Rock Bits, Limited, and Taylor Bros. & Company, Limited, and a director of a number of companies associated with the steel trade.

Obituary

Mr. J. A. DUNKLEY, of New Whittington near Chesterfield has died at the age of 88. All his working life had been spent at the Staveley Iron and Chemical Company's Old Works foundries, and he retired 20 years ago as foundry foreman after 52 years with the firm.

Mr. ARTHUR DORMAN, formerly managing director of Dorman, Long & Company, Limited, Middlesbrough, who retired from the board of directors last December, died on September 8 at the age of 76. He was the youngest son of the late Sir Arthur Dorman, founder of the company, and had had an active association with the concern for 53 years. He also served as chairman of several associated companies. He was a past-president of the Iron and Steel Institute, of the British Iron and Steel Federation, and of the National Confederation of Employers' Organizations. He had also been president of the Cleveland Ironmasters' Association, of the Cleveland Scientific and Technical Institutes, Middlesbrough and of the Tees-side Chamber of Commerce.

The death occurred last Saturday, at the age of 72, of Mr. WILLIAM HEPWORTH, one of the founders of Hepworth & Grandage, Limited, West Bowling, Bradford. He retired from the business on his 70th birthday when he was chairman and managing director of the company and deputy chairman of the parent company, Associated Engineering Holdings, Limited. He became a founder-director of the company when it was formed 47 years ago, and was present, as the last surviving founder, when the firm celebrated its golden jubilee last April. He saw the development of the firm from a small workshop to the present St. John Works, with subsidiary companies in Leeds, Shipley, and Yeadon, and associated companies in various parts of this country and in New Zealand, Australia and India.

Mr. GERALD STEEL, general managing director of the United Steel Companies, Limited, Sheffield, and president-elect of the British Iron and Steel Federation for 1957, has died at the age of 57. He joined the Steel Peech & Tozer branch of the newly-formed United Steel group in 1919—his father, Mr. H. Steel was a founder of Steel Peech & Tozer—and was appointed managing director of United Steel Companies (India) Limited, in 1928. He returned to this country in 1932 to become a director and general manager of Samuel Fox & Company, Limited, Stockbridge. He became a director of United Steel in 1941, then joint managing director, and finally in 1954, general managing director. He had been for several years a member of the Social and Industrial Council established under the chairmanship of the Bishop of Sheffield. He was awarded the C.B.E. in the 1956 New Year Honours, and was appointed a West Riding magistrate in 1941.

Recent Wills

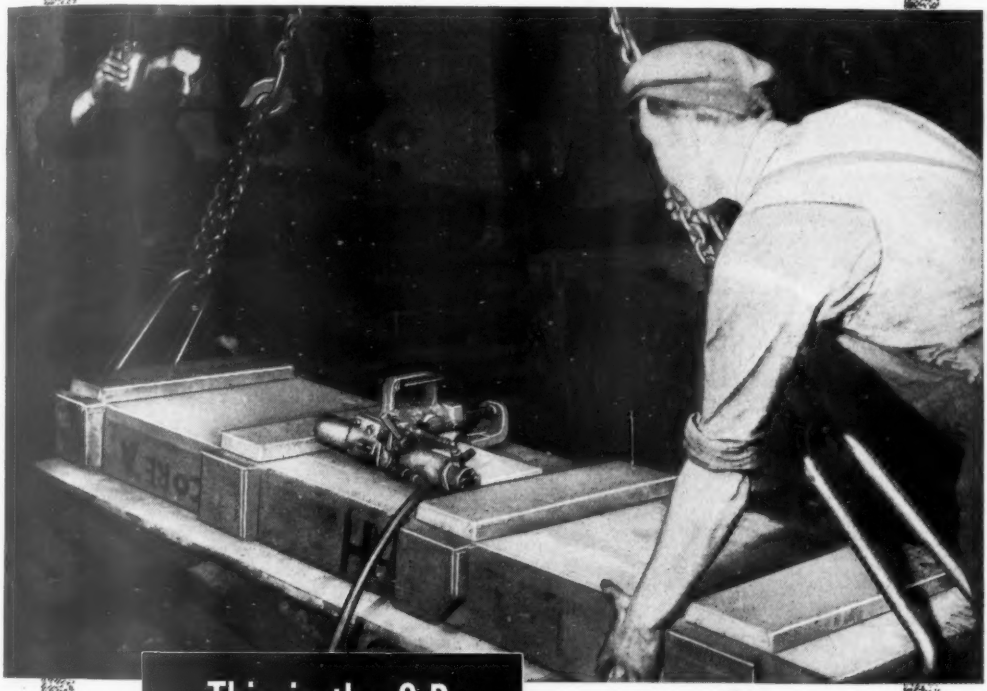
TAYLOR, HERBERT, for 63 years with Mather & Platt, Limited £83,118

COOK, Capt. C. R., formerly a director of British Mechanical Productions, Limited, and of the General Accessories Company, Limited £173,221

GEDDES, WALTER, formerly works engineer of W. T. Glover & Company, Limited, manufacturers of electrical wires and cables, etc., of Manchester... £11,678

BECK, J. W., a director of John Brown & Company, Limited, Associated Shipbuilding & Engineering, Limited, and of the North-West Rivet, Bolt and Nut Factory, Limited £16,104

CONSOLIDATED PNEUMATIC MAKE OVER 480
DIFFERENT MODELS OF POWER TOOLS



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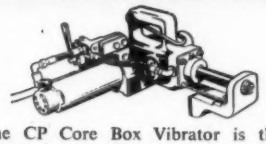

The CP Core Box Vibrator is the newest development in foundry equipment for core and pattern making departments. Cores weighing up to 3000 pounds are freed in less than 90 seconds. No more mallet work or sledging to loosen the core . . . just clamp the vibrator to the inverted box; its 9000 orbital vibrations per minute assure a perfect draw. Cores are free of flaws, damaged edges, distorted sections, dimensional variations . . . boxes remain in condition! Net weight of vibrator 34 lbs. Adjustable clamp jaw grip extends 3-7 inches. Write for the CP leaflet SP432.

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CP116

Raw Material Markets

Iron and Steel

With approximately 100 blast furnaces in operation, output of pig-iron keeps at a high level. Supplies of iron ore are adequate and most producers have good stocks available. Deliveries of blast-furnace coke are also satisfactory in quantity, increased tonnages being received from new coke-oven plants which have been brought into production recently.

Basic pig-iron for steel production continues to be the major product of the blast furnaces, up to 80 per cent. of current output consisting of that grade, the remainder being mostly of foundry irons, although an appreciable tonnage of hematite pig-iron also finds its way to the steelworks.

Generally, outputs of pig-iron now being obtained are sufficient for the requirements of all users, both for consumption and stock. The steelworks are receiving adequate tonnages from home furnaces, and although consignments continue to be received from overseas, mainly from the USSR against existing contracts, the steelworks are not dependent on them to maintain production, and most of the imported pig-iron is placed into stock.

The engineering foundries catering for the motor vehicle trade are fairly busy and their needs of low-phosphorus iron and hematite continue to be stepped up. Producing furnaces have so far been able to meet these needs. The light foundries, as well as the textile foundries, need more work. Most of the jobbing foundries are fairly busy, and with some of the engineering foundries are taking up fair tonnages of high-phosphorus pig-iron, but this grade is plentiful and more than sufficient to meet demands.

More pig-iron is now available for export than has been the case for some time, and if licences can be obtained most of the furnaces have tonnages available in all grades. Numerous inquiries are being received by export merchants, and while some tonnages are being shipped, severe competition from overseas producers has to be met.

A feature of the finished steel trade is the overbalancing demand for oil, gas, and water pipes. This rapidly developing industry, mainly sustained by export orders, involves heavy calls upon plate suppliers, already strained by activity in the shipbuilding and engineering industries. Rail and sheet mills are coping more successfully with current demands.

Non-ferrous Metals

Copper prices staged a sharp recovery on the London Metal Exchange on Friday, but the revival of interest was short-lived. There are too many imponderables to warrant much optimism yet and even the Board of Trade's decision to postpone its releases of copper from the Government stockpile failed to stimulate the market.

The LME quotation gained £21 15s. a ton in four consecutive increases last week, finishing at £205, but on Monday the price again fell below £200, cash copper closing at £194 15s. Last week's rise stemmed from a revival of demand at the lower prices which encouraged the US customs smelters to raise their quotations, but it would seem that buyers quickly filled their needs and the influence of this momentary boost to market morale was soon lost.

A statement last Friday by Sir Ronald Prain, chairman of the Rhodesian Selection Trust, appears to have had a dual effect. His view that long-term prospects gave no cause for concern was a bull point, but his remark that even at £200 the Copperbelt was still making a good profit could be read in two ways. Sir Ronald went on to suggest a cutback in production to take metal off the market, mentioning a figure of 10 per cent., and while such action would be calculated to bolster the price, it does not suggest great confidence in the immediate future.

Basically, the supply and demand position is weak, both here and on the other side of the Atlantic, and neither the Board of Trade statement nor the decision of RST to raise its selling price from £190 to £200 could prevent London copper prices falling when the market opened on Monday.

The Board of Trade's announcement referred to the 27,000 tons of copper which it was due to begin releasing in October at a monthly rate of not more than 2,700 tons. The present disturbed state of the market has lead to the decision to postpone releases for the time being. The position is to be reviewed towards the end of the year.

The other metals are resisting the weakening influence of copper with fair success. Tin has been helped by stronger markets in the East and there has been a better demand for cash metal. There is no improvement in the demand for lead and zinc and in the circumstances prices have held up well.

Forthcoming Events

SEPTEMBER 24

Incorporated Plant Engineers

South Wales branch:—Films—"Metal Degreasing by Trichlorethylene," and "Metal Pretreatment in Industry," followed by discussion, 7.15 p.m., at the South Wales Engineers' Institute, Park Place, Cardiff.

SEPTEMBER 25

Institute of British Foundrymen

Birmingham branch:—"Gating for Production," by L. Clarke, 7.15 p.m., at the James Watt Memorial Institute, Great Charles Street.

London branch: Presidential address by A. Talbot, followed by film and discussion, 7.30 p.m., at the Constitutional Club, Northumberland Avenue, W.C.2.

SEPTEMBER 26

Incorporated Plant Engineers

Sheffield and district branch:—"Design of Rolling Mills with Particular Reference to Hot and Cold Ferrous Mills," by M. Langen, 7.30 p.m., at the Grand Hotel, Sheffield.

Institution of Works Managers

Lancaster group:—"Function of an Industrial Medical Service," by Dr. Beards, 7.30 p.m., at the Royal King's Arms Hotel.

Institute of British Foundrymen

East Anglian section:—Works visit, at 2 p.m., to Laurence Scott & Electro-Motors, Limited, Norwich, and at 7 p.m., "S.-g. Iron—A Versatile Engineering Metal," by W. W. Braidwood, at Norwich City College, Ipswich Road, Norwich (joint meeting with the Eastern Region section of the Institution of Production Engineers and the Norwich Engineering Society).

SEPTEMBER 27

Incorporated Plant Engineers

Birmingham branch:—"Some Principles of Radiant Heating," by P. A. Coles, 7.30 p.m., at the Imperial Hotel, Temple Street.

Institution of Production Engineers

Leicester section:—"Work Measurement and its Uses for Management," by W. Hewett, 7 p.m., at the Cromwell Room, Grand Hotel. (Joint meeting with the Institute of Materials Handling and Leicester Work-study Group.)

SEPTEMBER 28

Institute of British Foundrymen

West Riding of Yorkshire branch:—Presidential address by H. Forrest, and film "Flow of Metal into Moulds," 6.30 p.m., at the College of Advanced Technology, Bradford.

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

September 18, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £23 17s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £24 1s. 3d.

Scotch Iron.—No. 3 foundry, £25 3s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 19s. 0d.; South Zone, £26 1s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £27 6s. 6d.; South Zone, £27 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £25 6s. 6d.; Scotland (Scotch iron), Zone S. 1, £25 13s. 0d.; Sheffield, £26 15s. 0d.; Birmingham, £27 4s. 0d.; Wales (Welsh iron), £25 6s. 6d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leics.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £53 5s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 9s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 12s. 7d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £96 0s. 0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3½d. to 2s. 3⅝d. per lb. Cr; 0.06 per cent. C,* 2s. 3½d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 0d. to 23s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £87 19s. 3d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £33 1s. 6d.; tested, 0.08 to 0.33 per cent. C, £34 1s. 6d.; hard (0.41 to 0.60 per cent. C), £35 3s. 0d.; silico-manganese, £44 2s. 6d.; free-cutting, £37 5s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £41 7s. 0d.; silico-manganese, £44 10s. 0d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.33 per cent. C, £38 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 18s. 6d.; acid, up to 0.25 per cent. C, £43 10s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £42 12s. 0d.; boiler plates (N.-E. Coast), £45 2s. 0d.; floor plates (N.-E. Coast), £44 1s. 0d.; angles, N.-E. Coast, £40 6s. 6d.; joists, N.-E. Coast, £40 2s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., and flats, 5 in. wide and under, untested soft basic, 50 tons and over, £40 8s. 0d. (under 10 tons to 4 tons, £41 5s. 6d.; under 4 tons to 2 tons, £41 10s. 6d.); hoop and strip, coils, £40 10s. 0d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £45 16s. 0d.; black sheets (hand mill), 24 g., £59 4s. 6d.; galvanized corrugated sheets, 24 g., £68 17s. 0d

Alloy Steel Bars.—1 in. dia. and up: Nickel, £69 9s. 6d., nickel-chrome, £100 12s. 6d.; nickel-chrome-molybdenum, £112 16s. 6d.

NON-FERROUS METALS

Copper.—Cash, £198 0s. 0d. to £198 10s. 0d.; three months, £201 10s. 0d. to £202 0s. 0d.; settlement, £198 10s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 1s. 10½d. per lb.; rods, 219s. per cwt. basis; 20 s.w.g., 252s. 3d. per cwt.

Tin.—Cash, £743 10s. 0d. to £744 0s. 0d.; three months, £743 10s. 0d. to £744 0s. 0d.; settlement, £744 0s. 0d.

Lead (Refined Pig).—Second half September, £89 10s. 0d. to £89 15s. 0d.; second half December, £90 0s. 0d. to £90 5s. 0d.

Zinc.—Second half September, £72 15s. 0d. to £73 0s. 0d.; second half December, £73 5s. 0d. to £73 10s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £110 15s. 0d.; rolled zinc (boiler plates), all English destinations, £108 10s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £85.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 6¾d. per lb.; sheets to 10 w.g., 168s. 9d. per cwt.; wire, 2s. 4¼d.; rolled metal, 168s. 9d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £136; B6 (85/15), — ; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £199; HTB2 (38 tons), £254; HTB3 (48 tons), — .

Gunmetal.—BS1400, LG2 (85/5/5/5), £172; LG3 (86/7/5/2), £183; G1 (88/10/2/½), £240; (88/10/2/1), — .

Phosphor Bronze.—BS1400, PB1 (AID released), £258 per ton.

Phosphor Bronze Strip, etc.—Strip, 242s. 3d. per cwt.; sheets to 10 w.g., — per cwt.; wire, 3s. 7½d. per lb.; rods, 2s. 11¾d.; tubes, 2s. 11¼d.; chill cast bars: solids 2s. 10¾d., cored 2s. 11¾d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide x 0.056, 3s. 5½d. per lb.; round wire, 10g. in coils (10 per cent.), 3s. 10½d.; special quality turning rod, 10 per cent., ½ in. dia., 3s. 10¼d., in straight lengths, 3s. 9¼d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £85 0s. 0d. to £87 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, £223; AB2, £240.

* Average 68-70 per cent.